SCIENCE

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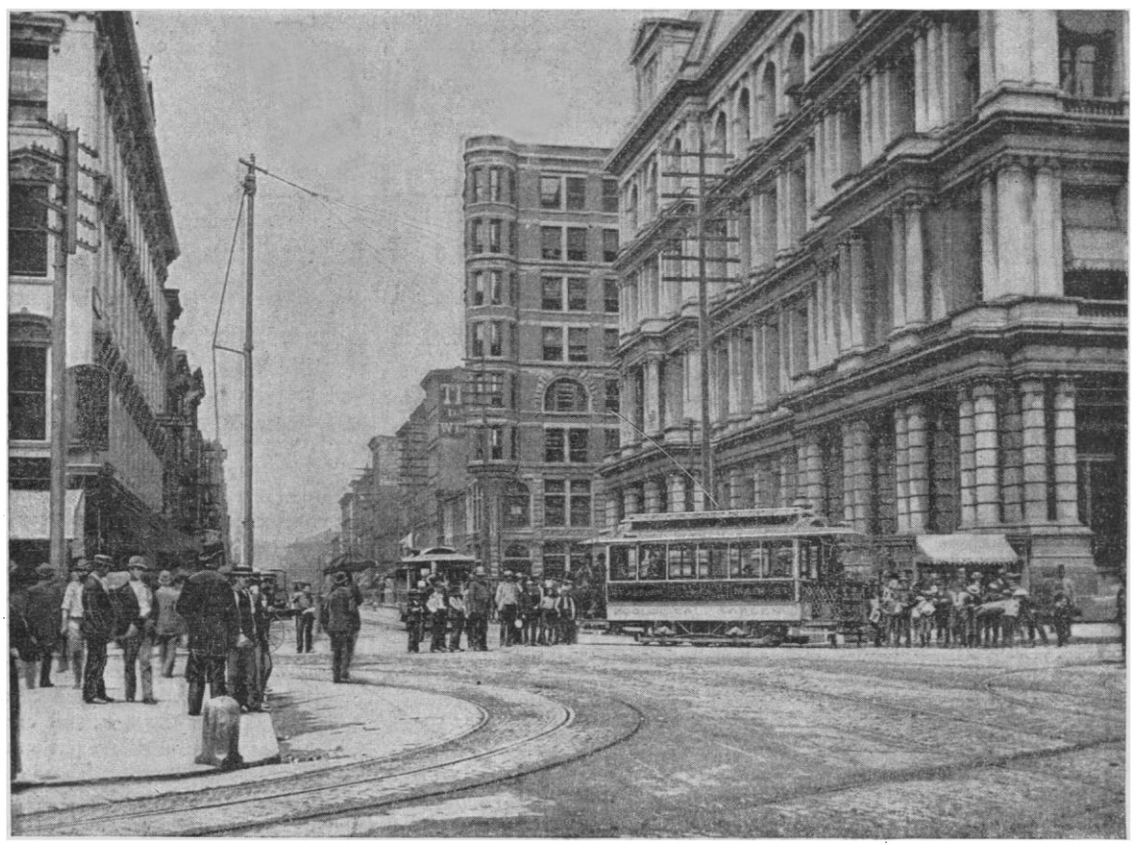
CINCINNATI INCLINED-PLANE RAILWAY.

IN the accompanying engraving we give a view of one of the Sprague electric cars on the Cincinnati Inclined-Plane Street-Railway. This railway runs from the centre of Cincinnati to the foot of an incline, where the cars are hoisted on elevators to the top of the bluff which surrounds Cincinnati, and there run by means of electricity through the suburbs to the Zoölogical Gardens. This is the first electric incline installed in Cincinnati, and shows how successfully the street-railway problem in that city has been solved, and how a substitute for cable-roads has been gained. The view given shows the car rounding the corner of Fifth and Walnut Streets; the post-office being on the right, and Fountain Square on the left.

The style of poles used is shown by a single iron pole on the corner, and is a sample of the kind of poles used throughout the line. These iron poles are only four inches at the top, and are very much lighter and neater-looking than the ordinary electric-railway pole. In the residential district the streets are bordered with trees, so that the poles are completely covered, and by the casual observer cannot be seen.

On Fifth Street, just to the right of the poles shown in the engraving, there is a stretch of five hundred and fifty feet where only three span wires are used, although the street is two hundred feet wide. This could only be possible with the light silicon-bronze trolley wire of the Sprague system, by means of which only a small portion of current is required to be carried from the centre of the street, while the greater portion is carried on main conducting-wires on the side of the street.

The equipment of this road includes twenty cars, all equipped with the Sprague improved electric-railway motor, and all the latest improvements adopted by the Sprague Company upon their most recent roads. It may be called one of the finest electric railways in the country. The equipment is first-class throughout. The track is laid entirely of steel rails, and iron poles are used throughout the entire electric line. The employees of the road are all dressed in uniform; the men in charge of the motor having a band around their hats with the word "motorneer" inscribed, while the conductors are designated in an appropriate manner.



CINCINNATI INCLINED-PLANE RAILWAY.

The president of this road is Mr. H. H. Littel, who is widely known in street-railway circles as one of the most successful street-railway managers in central United States. The general manager of the road is Mr. H. M. Littel, to whom the success of the road is in a great measure due.

TRANSMISSION OF POWER.

THERE is a new device for the transmission of power before the public which is attracting a great deal of attention. It consists in running a loose belt between two pulleys instead of the usual way of encircling the pulleys with a belt. Simple as this arrangement is, it is a very efficient method by which power can be transmitted from one shaft to another. The most remarkable thing about it is the fact that more power can be transmitted in this way, with less pressure on the bearings, than in the old way. This may seem at first sight to be unreasonable, but it can be fully demonstrated that this is a fact. It is said that this is owing to the fact that the belt is loose. It is in this feature that it differs from all other frictions, and bases its claims for superiority.

We illustrate one application of this principle to the driving of dynamos directly from the fly-wheels of an engine. A great saving in belting, room, and an appreciable saving in power, are among the advantages of this system, and an unusually steady light is produced.

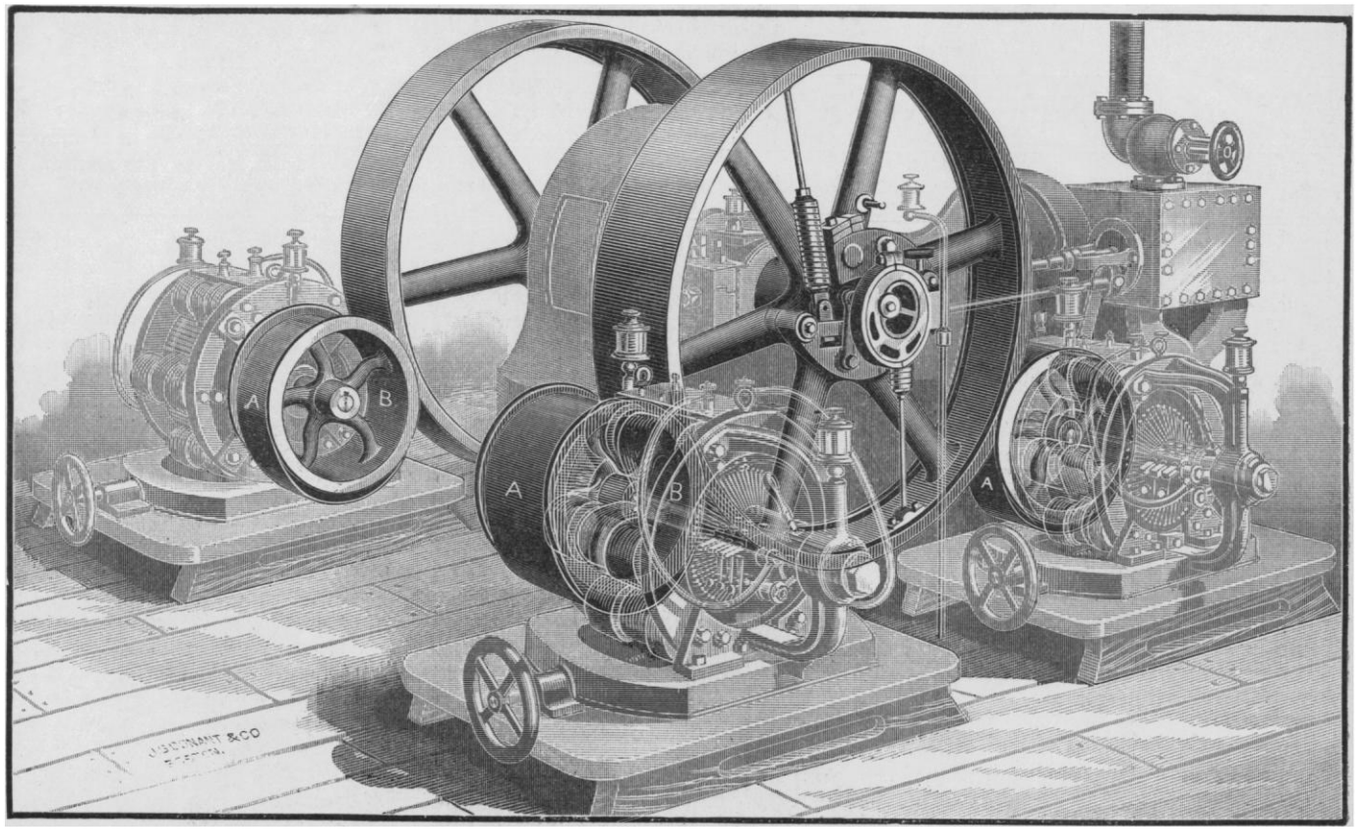


FIG. 1. — DYNAMOS DRIVEN BY MEANS OF EVANS FRICTION BELT.

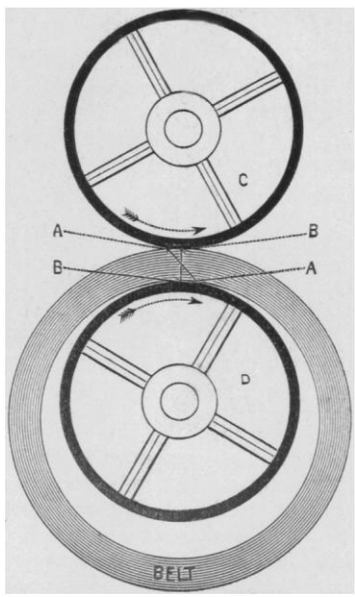


FIG. 2. — PRINCIPLE OF THE EVANS FRICTION BELT.

The arrangement of this system is shown in Fig. 2, where *C* is a driving-pulley, which drives pulley *D*, through the medium of the belt. The friction of pulley *C* on the belt produces a tangential force in the direction of rotation. In a similar way, there will be a corresponding force acting in the opposite direction on the under side of the belt, due to the resistance of the driven pulley. These two forces constitute a static couple. The belt is free to act under its influence, and two things take place. The tendency to rotation will cause the pressure to be transmitted in an oblique direction, as shown. These two forces will also produce an upsetting or fulling action, which will thicken the belt, and create pressure enough to drive, after a slight pressure is first put on the belt.

Practical men will appreciate at once the advantage of having a simple and durable way in which they can start and stop one or more dynamos independently of each other, and this without slowing down the engine. This system has been in continual use in stations for some time, and has given universal satisfaction; and large plants which are being built in the vicinity of Boston are preparing to adopt this arrangement.

The same principle is applied by the inventors to the transmission of power from one cone to another, for the purpose of obtaining a variable speed. They have also attached a governor to the driven cone in special cases, where a steady speed is required from a source that is variable, and a very close regulation has been thus obtained. This is especially valuable for driving dynamos where water-power is used.

The patents which control these principles are owned by the Evans Friction Cone Company of Boston. The results of tests which they have made are very interesting. The method seems to be almost universally applicable to all places where power is used.

THE CAMEROONS DISTRICT OF WEST AFRICA.

AT a meeting of the Geographical Society of Berlin, July 6, 1889, Capt. Kund gave a brief *résumé* of the results of the two expeditions led by him into the country lying inland from the Batanga coast, in the Cameroons district of West Africa, which is reported in the "Proceedings of the Royal Geographical Society." The opposition which the coast population offered to the entry of the expedition was only passive, but nevertheless very irritating. All kinds of stratagems, lies, deceits, and false directions as to routes—of course to no purpose—were tried by them. It was owing to the calumnious reports spread by the inhabitants of the coast, that the expedition, as it penetrated farther into the interior, encountered hostility from the natives, who, made uneasy by the reports conveyed to them by traders from the coast, became fearful, as the white men approached, for their wives and stores of ivory.

The violent attack made upon the expedition by the Bekok, on the first return to the coast in the spring of 1888, rendered it absolutely necessary, in order that the prestige of the white man in these regions should be maintained, for the party to return again as soon as possible to that part of the country; for the news had spread far and wide that the natives had suceeded in killing the white men, and in destroying the expedition. The re-appearance of the supposed dead men was consequently a great moral success, and the second advance presented hardly any difficulties. Among many tribes the expedition was even received with songs and dances, and everywhere the suspicion that the expedition had come for the purpose of taking vengeance quickly disappeared. Capt. Kund, on this occasion, announced most emphatically that nothing was further from his intentions than to take any unfair advantage of the natives, that he had left no stone unturned in order to convince them of his peaceable intentions, and that the first shot had never been fired from his side. It was continually the want of interpreters which caused the complications in which on different occasions he became involved with the natives.

Although the second journey resulted in little that is new from a geographical point of view, inasmuch as the route followed differed in unimportant points from that taken on the first occasion, still the detailed knowledge of the country was considerably increased, and a much more complete insight into the ethnographical conditions of the region was obtained. Thus the expedition became acquainted with a race of people, which, on the first journey, had remained quite unknown. The inhabitants of the primeval-forest region are of remarkably small stature, although not dwarfs, and are yellow-skinned. They roam through the forests without having any fixed abodes, and live by the chase. These people appear to represent the aborigines of the country, who were the first to make paths in the virgin forest. They call themselves the Bojaëli, but are named Baüea by the other tribes. They kill elephants with spears, and possess extraordinary skill in finding their way through the dense forest.

The ethnographical features of the southern Cameroons territory, between the Sannaga and the Campo, are, according to the present state of our knowledge, as follows. Between the Sannaga and the Njong dwell the important group of the Mvelle (Bakoko), who are very unequally distributed through the region of primeval forest as far as the coast range of mountains. The coast itself is here uninhabited. South of the Njong, the Banoko and Bapuko (the so-called Batanga people) live on the coast. They have probably come here from the north. In the rear of them dwell the Kasjua, called by the Batanga people Mabea. They belong to another race, and have probably immigrated from the south. The inhabited part of the coast is, with the exception of the banks of the Njong and Lokundje, where narrow belts of population — on the former the Bakoko, and on the latter the Kasjua and Bakoko intermingled — extend into the interior, nowhere broader than about nine miles. Then follows the uninhabited region of primeval forest, about one hundred and twenty miles broad, in which only the Bojaëli live. In the valleys of the first steep mountain-range the Ngumba live. They call themselves Mavumba, and are closely related to the Kasjua, having probably in the same way immigrated hither from the south. In the north they border at the Lokendje River, on the Batoko; in the south, on the Bulei. The latter belong to the Fang group, and have pushed their way along the right bank of the Ntembe (Campo River) almost as far as the coast. They embitter the lives of the Ngumba people by constant attacks. East of the Ngumba territory, the country for a stretch of about forty-five miles is again uninhabited, and it is there that the second steep ascent to the great plateau of the interior of Africa commences. The plateau itself is extraordinarily densely populated, and by people closely related in their language to the Fang (Mpangwe, the Fans of Du Chaillu) on the Ogowe. Some porters belonging to the latter race accompanied the expedition, and they very quickly learned to make themselves understood by the people of the plateau. The sequence of tribes from the left bank of the Sannaga is as follows: the Jetoni, Botinga, Kolle, Jetudi, Jeundo, Bane, Tinga, Baba, Janguana, and Bulei in the south. The Jeundo and Tinga are distinguished in the most favorable manner from the peoples living farther west. They are of remarkably tall and slim stature, are well nourished, and thoroughly healthy, Their features are, in the case of both sexes, extraordinarily regular. They have a marked tendency to harmless gayety and dancing. The men wear round the loins a piece of bark cloth. It is peculiar that the women for covering their back parts use large bunches of grass threads colored red-brown, while their front parts are barely concealed by a banana-leaf. In the midst of this interesting people, at a point situated about 3° 48′ north latitude and about 12° east longitude, and close on the boundary line between the Bantu and Sudan negroes, the expedition erected their station, at which Lieut. Tappenbeck is at the present time stopping alone.

SPRAYING WITH THE ARSENITES.[1]

NINE years ago, at the first meeting of this society, I presented a paper upon the use of Paris-green as a specific against the codling-moth. In that paper I gave the results of careful and elaborate experiments, which settled two facts which were very important in economic entomology, — first, that Paris-green was efficient as a preventive of the ravages of the codling-larva; and, second, that such use was entirely safe in respect to poisoning the fruit. To-day, less than a decade from the date of the discovery of this remedy, this method to combat the worst insect-pest of the apple-grower, is generally adopted by the more intelligent orchardists of our country. Its value is now universally conceded. Easy and cheap methods to apply the insecticide are now known and generally adopted.

For several years myself and others have been experimenting, in hopes to find that this same insecticide was equally efficient to destroy the plum curculio. For six or seven years I have sprayed plum-trees once, and even twice, with no apparent good. Test-trees close beside the trees sprayed, and that were not treated, were as free from attack as were the trees that were sprayed, and the trees treated were no more exempt from attack than the others. Thus I was convinced that this insecticide was of no value in this curculio warfare. Several of my horticultural friends, in whose ability to experiment and observe correctly I had great confidence, had tried this remedy with very satisfactory results. In 1888 I studied this matter very closely, and concluded that as the plum is a smooth fruit, with no calyx-cup, like that of the apple, in which the poison may lodge, and as the curculio lays its egg anywhere on the smooth rind, the poison would be very easily washed off, or even blown off by the wind. I thus concluded that my want of success was very likely due to a want of thoroughness. In 1888 I sprayed certain trees three times at intervals of eight days, and omitted to treat other trees close alongside. The benefit from spraying was very marked.

I also found that carbolized plaster (one pint of crude carbolic acid to fifty pounds of plaster) was quite as efficient to repel the curculio as was the arsenites. This was also applied three times. The season was very dry, and there were few or no rains to wash off the insecticides. This year I repeated the experiments both with the London-purple and with the carbolized plaster, but with no success. All the trees were severely attacked, and all the plums lost. This year we had almost daily rains, which were frequently quite severe.

[1] Abstract of a paper by A. J. Cook, read at Toronto, Aug. 26, before the Society for the Promotion of Agricultural Science.

I believe I am warranted in the following conclusions: the arsenites and carbolized plaster will protect against the plum curculio if they can be kept on the tree or fruit; but, in case of very frequent rains, the jarring method will not only be cheaper, but much more effective. Again: as our wild fruits are more cleared away, we must have plums in our orchards to protect the apples from the curculio. When apples are seriously stung, they become so gnarled and deformed as to be worthless. It will pay, then, to set plum-trees near by or among the apple-trees. Then we will escape mischief among our apples from the curculio, and will only need to spray our apples once to destroy the codling-moth, and can treat the plum-trees three or four times with Paris-green or carbolated lime, in case we have only occasional showers, or can jar the trees when the rains are very frequent. For the apples we can use London-purple (one pound to two hundred gallons of water); for the plums we must use Paris-green (one pound to two or three hundred gallons of water). If the carbolated plaster is preferred, we use one pint of crude carbolic acid to fifty pounds of land-plaster. This is thrown freely over the trees, so as to strike every plum on the tree which is being treated.

Another very important practical point has been suggested by the past season's experience with these insecticides. I refer to the danger of applying them before the blossoms fall. Bees are quite as susceptible to these poisons as are the codling-larvæ and curculio. In their good work of collecting nectar and fertilizing the blossoms, they are very certain to take the poison as well, if the trees have been sprayed. Of course, there is no excuse for spraying at so early a date, as neither the curculio nor codling-larvæ commence their attack till the blossoms fall. Thus for the object in mind, as well as for the safety of the bees, delay should be insisted upon. I think we as scientists, and all educated men, should pronounce vehemently and with one voice against spraying our fruit-trees with the arsenites till the blossoms have all fallen. We should even go further: we should secure the enactment of laws which would visit any such offence with fine and imprisonment. Such laws would prove a ready and active educator.

In the past season many bee-keepers have lost severely from the neglect of their fruit-growing neighbors to observe this caution. I will only mention two cases. Mr. John G. Smith, Barry, Ill., writes, "One of my neighbors, owning an orchard of about one hundred acres of apple-trees, sprayed the trees with Paris-green and water just as they were in full bloom. The result is that ten or twelve bee-keepers are ruined." The imago no less than the larvæ and pupæ were destroyed. Mr. J. A. Pearce, Grand Rapids, Mich., was also a heavy loser from the same cause. His bees likewise died in all stages of development.

It is well to remember and to urge that this loss is not confined to the bee-keeper, for the fruit-grower as well as the apiarist needs the bees and their work to insure his best success. It only requires, then, that our people know the truth, to insure againt loss n this direction.

Another practical question of no small moment in this use of the arsenites refers to injury to the foliage of the trees treated. In an elaborate series of experiments the past season, we desired to learn the effect on different trees of the different arsenites, and whether the date of treatment and atmospheric condition had any influence. From these experiments I think we are warranted in the following conclusions: —

First, London-purple is more injurious to the foliage than is Paris-green, and white arsenic (arsenious acid) is more harmful than is either London-purple or Paris-green. This is doubtless owing to the soluble arsenic, which is quite abundant in London-purple, and almost absent in Paris-green. In one experiment it was seen that the colored water after London-purple fully settles is very destructive to foliage, while aniline is not at all harmful. This agrees with the experiments of Professor C. P. Gillette, made in 1888, where white arsenic was found very destructive to foliage.

Second, Peach foliage is especially susceptible to injury, and cherry foliage the least so of any of the kinds treated.

Third, It would seem that London-purple and white arsenic, used just before a rain, are more harmful than when used during a drought. We not only saw greater injury when a rain followed spraying within two or three days, but secured the same results by spraying, soon after treatment, with pure water. This also accords with the view that the injury comes from the presence of soluble arsenic.

Fourth, It would seem that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or, better, a few weeks. For ten years I have sprayed both apple and plum trees in May, and for several years with London-purple, and often used a mixture as strong as one pound to one hundred, or even fifty, gallons of water; yet in most cases no damage was done. This year I sprayed several trees in May, using one pound to one hundred gallons of water, with no damage. In June and July, spraying the same trees with a mixture only one-half as strong did no slight injury. This fact, if fact it be, accounts for the few reports of injury in the past, even with a stronger mixture, and the frequent reports of damage within a year or two, even with a dilute mixture. Then the spraying was confined to May: now it reaches to June, or even to July.

Fifth, London-purple may be used on apple, plum, cherry, pear, and most ornamental trees, but on these should never be stronger than one pound to two hundred gallons of water. If the application is to be repeated, as it must be for the curculio, to prove effective, or if it is to be used in June or July, Paris-green should be used in the same proportion as above, or else we should only use one pound of London-purple to three hundred gallons of water. I now think that this necessity is more due to time of application than to the fact of increased quantity of the poison.

Sixth, If the arsenites are to be used on the peach to defend against the curculio, Paris-green only should be used, and that not stronger than one pound to three hundred gallons of water. With the peach the poison is not only absorbed, coloring the tissue purple or brown, but even the petiole or stem of the leaf is weakened, and the leaf falls. Thus in several cases where we used London-purple (one pound to two hundred gallons of water) or white arsenic, the peach-leaves all fell off. White arsenic colors the tissue the same as does the London-purple, showing once more that it is the soluble arsenic, not aniline, that does the mischief.

Seventh, The injury done to the foliage is never immediately apparent. It usually shows somewhat the second day; but the full injury is frequently not manifest till the fifth day, and often not till the tenth.

Another important practical question which I have tried to settle this season (1889) concerns the danger of pasturing under trees which have been sprayed with the arsenites.

A gentleman wishing to spray his orchard, in which he was pasturing seventy-five hogs, consulted me as to the wisdom of doing so without first removing the swine. I told him I believed there was no danger. I said, "Use a mixture of one pound of London-purple to two hundred gallons of water, watch your hogs closely, and, if any seem affected, remove all at once, and I will be responsible for damages to the amount of twenty-five dollars." The gentleman did so, and reports no damage.

In the following experiments I used the mixture of twice the strength which should be used, that the experiment might be the more convincing. I used one pound to one hundred gallons of water. In every case the spraying was very thoroughly done. Care was taken that every twig and leaf should be drenched.

In tree No. 1 a thick paper was placed under one-half of a rather small apple-tree. The space covered was six by twelve feet, or seventy-two square feet. The paper was left till all dripping ceased. As the day was quite windy, the dripping was rather excessive. In this case every particle of the poison that fell from the tree was caught on the paper. Dr. R. C. Kedzie analyzed the poison, and found four-tenths of a grain. Tree No. 2 was a large tree, with very thick foliage. Underneath this tree was a thick carpet of clover, blue-grass, and timothy just in bloom. The space covered by the tree was fully sixteen feet square, or equal to two hundred and fifty-six square feet. As soon as all dripping had ceased, the grass under the tree was all cut very gently and very close to the ground. This was taken to the chemical laboratory and analyzed by Dr. R. C. Kedzie. There were found two and two-tenths grains of arsenic. Now, as our authorities say that one grain is a poisonous dose for a dog, two for a man, ten for a cow, and twenty for a horse, there would seem to be small danger from pasturing our

orchards during and immediately after spraying, especially as no animal would eat the sprayed grass exclusively. To test this fully, I sprayed a large tree over some bright tender grass and clover. I then cut the clover carefully, close to the ground, and fed it all to my horse. It was all eaten up in an hour or two, and the horse showed no signs of any injury. This mixture, remember, was of double the proper strength, was applied very thoroughly, and all the grass fed to and eaten by the horse. This experiment was repeated, with the same result. I next secured three sheep. These were kept till hungry, then put into a pen about a tree under which was rich, juicy June-grass and clover. The sheep soon ate the grass, yet showed no signs of any injury. This experiment was repeated twice, with the same result. It seems to me that these experiments are crucial, and settle the matter fully. The analyses show that there is no danger: the experiments confirm the conclusion.

Thus we have it demonstrated that the arsenites are effective against the codling-moth; that in their use there is no danger of poisoning the fruit, and, when used properly, no danger to the foliage, nor to stock that may be pastured in the orchard.

PLANT-LIFE OF ARABIA FELIX.

PROFESSOR SCHWEINFURTH, at a recent meeting of the Berlin Geographical Society, spoke of his journey to Arabia Felix, undertaken from November, 1888, to March, 1889, with the object of making botanico-geographical studies. Stimulated by a journey of the French botanist, A. Deflers, in the year 1888, Schweinfurth determined to make one of the chief objects of this journey to Yemen the obtaining of authentic specimens of a large number of the species of plants described by the Swede, Peter Forskal, the botanist of the Niebuhr expedition (1761), who, when barely twenty-seven years old, fell a victim to the climate after much ardent activity in exploration. For what reason the scientific world, considering the complete opening-up of this ancient land of civilization, has deferred so long the exploration of the country, it is difficult to understand; since Yemen, not only since the recent taking-possession of the country by the Turks, but for a long period, has been distinguished, above all other parts of South Arabia, for the safety of travel and the well-tested courtesy of the inhabitants towards Europeans. Several plants, useful to man and cultivated by him, have, through the medium of South Arabia, found their way to the civilized countries of the north. Some, like coffee, appear to have been converted here for the first time from their natural state into the service of man. In ancient times there were in the first place various fragrant substances exported from here. On that account the country was named, from the oldest dynasties of the Pharaohs down to the later Roman period, the holy land, the land of the gods. The Punt country of the old Egyptians is surely not only to be looked for in Africa, but denotes in the wider sense the territory on both shores of the southern part of the Red Sea. The designations "stair" mountain and "step" mountain, both in the old hieroglyphics as well as in Ptolemy and in the works of Arabian geographers, Yakut and Hamdany, refer especially to the terraced cultivated slopes of South Arabia, constructed with such a large expenditure of labor, while they possess no meaning if applied to the Somali country. The ancient Egyptians took special care of certain trees, which were dedicated to particular deities. Thus the sycamore-tree was consecrated to Hathor. From the oldest tombs found in the Pyramids, and belonging to the fourth dynasty, down to the latest lists of offerings of the Ptolemaic-Roman epoch, the fruit of the persea (*Mimusops schimperi*), the "aschd," appears as a continually recurring gift to the gods and to the departed. The tree was regarded as specially sacred, and was dedicated to the greatest god, Rê, the sun, and on numerous occasions the leaves and fruit of both trees have been brought from the tombs to the light of day. The foreign origin of the tree called *Persea* in the Grecian authors, not to be confounded with the *Persea gratissima* of to-day, as coming from Ethiopia, by which term Abyssinia as well as South Arabia may be understood, is attested by Strabo and Diodorus, and confirmed by the present widespread existence of wild-growing species. For several centuries the tree has entirely disappeared from Egypt. On the other hand, the sycamore, although only in a cultivated state, is still to be found in Egypt and certain parts of Syria. Schweinfurth has now discovered in Yemen in numerous places fig-trees, in the case of which he has proved botanically that these trees, called in the mountainous country *chanes*, and in the lowlands *burra*, are completely identical with the Egyptian sycamore. At the same time the traveller found, in the lowest mountain regions of Yemen, the *Persea* of the ancients growing wild; and it was there designated with the old Arabic name *lebbach*, which was known to the Arabian geographers of the middle ages. The *Mimusops schimperi* was formerly only found in North Abyssinia. With the disappearance of the tree in Egypt, for the protection of which the Emperor Arcadius made a special law, which is still preserved, there disappeared in later Egypt also the proper meaning of the name *lebbach;* and at the commencement of the last century the term was transferred to a species of acacia (*Albizia zebbell*) introduced from India, which is to-day the most widely spread tree in Egypt. In connection with the traditions inscribed on the ancient monuments, the fact that in Yemen to-day there are still species of trees growing wild, which several thousands of years ago and during a period of three thousand years were held in Egypt to be sacred as symbols of divine worship, throws important light upon the old relations subsisting between the two countries.

HEALTH MATTERS.

THE INHALATION OF DUST. — Dr. Kunze, in his inaugural thesis for the M.D. degree of the University of Kiel, publishes as a contribution to the diseases caused by the inhalation of dust a series of examinations of lungs so affected. In all these, as stated in a recent number of the London *Lancet*, dust was found microscopically; and, after chemical tests in the various anatomical and histological parts of the lungs and in the interior of the lymphatic vessels, numerous leucocytes were found covered with the dust. Being arrested in its progress, it causes inflammation, producing hyperplasia of connective tissue, especially where a dense network of lymphatic vessels exists. Dr. Kunze also proved that the degree of alteration in so-called "dust lungs" depends not merely on the quantity of the dust inhaled, but also on its greater or less morphological power of injuring the tissue. He concludes from his experiments that even the greatest alterations in these lungs — such as nodes, indurations, and vomicæ — are mainly produced by the inhaled dust, and that tuberculosis is only an occasional coincidence. The least serious alterations in the lungs resulted from the inhalation of lamp-black, the particles of which are very fine and little injurious; the most serious, from the dust inhaled by earthenware manufacturers and stone-masons. The lungs of a locksmith showed only a moderate hyperplasia of connective tissue, the dust consisting partly of the finest particles of iron. In a worker in oxides of iron the lungs were found full of small granules, and the morbid changes in the tissues were very considerable. The lungs of gold-miners were generally indurated and atrophied: the dust in these cases is exceedingly fine. Sand produced numerous circumscribed hard nodules and thick indurations. In cloth-manufacturers, the lungs, in spite of their contact with an enormous quantity of organic dust, presented but few indurations. In the lungs of two stone-masons, induration and tuberculous disintegration were observed: all the other lungs were entirely free from tubercles of any kind, — an observation which was verified by the absence of tubercle bacilli in the muco-pus in the vomicæ.

CONGRESS FOR TUBERCULOSIS. — The second congress for tuberculosis will be held in Paris during the latter part of July, 1890. Professor Villemin will act as president. The following questions are to be discussed: 1. The identity of human and bovine tuberculosis, also that of other animals; 2. The bacteriological and morbid associations of tuberculosis; 3. The isolation of tuberculous subjects; 4. The agents capable of destroying Koch's tubercle bacillus, with a view to the prophylaxis and therapeusis of the disease in man.

MEDICINE IN JAPAN. — In Japan there are thirty-one schools of medicine, one of dentistry, and two of veterinary surgery. The University of Tokio (the Imperial University) has over twelve hun-

dred students, and an average of one hundred medical students graduate yearly. In Tokio alone there are numerous active medical societies and over twenty hospitals.

RUSSIAN STUDY OF INFECTIOUS DISEASES. — An institute has been founded in St. Petersburg for the experimental study of infectious diseases and for prophylactic inoculations. The institute is to be under the charge of Professor B. Anrep.

FRENCH AND GERMAN TOBACCO. — The *Progrès Medical*, July 13, 1889, gives a brief account of the international congress to protest against the abuse of tobacco, which was recently held in Paris. M. Ortolan made the interesting statement that the proportion of nicotine in tobacco is less when the stalks grow close together, and when the leaves are numerous and placed very low upon the trunk. This is the reason, he said, why the German, who smokes more than the Frenchman, poisons himself less. In the former country tobacco-growing is free, whereas in France it is regulated by the government, and the number of leaves to the stalk is limited. French tobacco, he said, contains as much as six per cent of nicotine.

JELLY-FISH STING. — Bathers who have encountered the long tentacles of a medusa will be pleased to know, says *Medical News*, that the "sting," or erythema, may be speedily relieved by the application of water rendered alkaline by common washing-soda, in the proportion of an ounce of soda to about two quarts of water.

THE DANGERS OF CARBOLIC ACID. — The following letter of Dr. Th. Billroth of Vienna has been published in the *Lancet*: "I have lately seen four cases in which fingers which had suffered a most insignificant injury became gangrenous through the uncalled-for application of carbolic acid. Carbolic acid is now much less used in surgery than formerly. We have only gradually become acquainted with its dangers. The acid may not only cause inflammation and gangrene, but also blood-poisoning, and so may even prove fatal. It is useful only in the hands of a skilful surgeon, and ought never to be used without his advice."

VENTILATION IN ICELAND. — The extreme cold of the winter in Iceland reduces the system of domestic ventilation in that country to very primitive principles. A traveller there was so choked one night by the close atmosphere of the air-tight little chamber in which he slept, with all the male members of the family, as to be compelled to wake his host, who sprang out of bed at the call, pulled a cork from a knot-hole in the wall for a few minutes, and then, replacing the cork with a shiver, returned to bed.

LEPROSY IN HAWAII. — It is estimated that there is one leper to every forty of the inhabitants of the Sandwich Islands. Speaking of leprosy, *Medical News* states that a Chinese leper was recently discovered in the Sacramento jail. He had been sent there for refusing to pay a poll-tax.

FREEDOM OF AIR FROM GERMS. — Dr. Le Fort says that microbes are never conveyed in the air, but only by contact with the fingers, instruments, etc.

CHOLERA. — Two cases of cholera, one of which terminated fatally, are reported to have occurred in Hungary. Cholera has appeared also in Mesopotamia, as shown by the following despatch, published in the Marine Hospital Service *Bulletin* under date Sept. 13: "Cholera, since July 27, made its entry into Mesopotamia in as mysterious a manner as it made its appearance into Egypt in 1883. It is certain that it penetrated from Bombay *via* Bassora; it could not as yet be determined how, perhaps (as in Egypt) through Arabian stokers (firemen), who are employed on the English steamers of the Bassora-Bombay line, and who, upon their arrival at Bassora, go to their homes. At first cholera appeared at Schatra (3,000 inhabitants), two and a half days' journey from Bassora, at the Schatel-Hay Canal, which connects the Tigris with the Euphrates River. In a few days, from July 27 to Aug. 6, 308 persons died. On the 1st of August it appeared at Naszrie (8,000 inhabitants), southerly from Shatra, near the embouchure of the Schatel-Hay into the Euphrates, — a city which was founded in 1872 by Natir Pacha, the Montefik sheik. From the 1st to the 9th of August, 293 deaths occurred, on the 8th of August so many as 85. The houses are situated upon the flat marsh-land, and are only reed huts. The inhabitants carry on the culture of rice and some cattle-raising. It finally made its appearance at Bassora on Aug. 6, and at first an Arabian girl died who had come there ten days before from Filie in Persia. On Aug. 9, 15 deaths occurred there. The reports of Gazala, the sanitary physician, do not allow any doubt to arise as to the diagnosis."

MENTAL SCIENCE.

Experiments upon Association of Ideas.

IN *Mind*, No. 54 ("Mental Association investigated by Experiment," by J. McK. Cattell and Sophie Bryant, D.Sc.), is printed an account of experiments upon certain very usual mental products, which commands interest not so much for the intrinsic value of the results obtained as for the suggestiveness of the inquiry that it opens up. An association as ordinarily studied begins with the perception of a written or spoken word, includes the calling-up of another idea by the first, and ends with the expression of the associated word by mouth or pen. The characteristic element in the process is the central one, while the perception and the expression factors have a somewhat mechanical *rôle* to play, and must be eliminated in the study of the association process *per se*.

The two aspects of association studied in the present research are (1) the time taken up in mental association, and (2) the nature of the association. The difficulty in studying the former is that the time taken up by perception and expression is not absolutely separable from the association time, the two processes in part overlapping. In experiments specially designed to study the perception and expression times, it was found that it takes about half a second to see and name a word, so that approximately the difference between the entire time and half a second will be the association time. The same 20 nouns were used with about 500 observers, and 6 observers answered to groups of about 250 words. Former experiments in which it was possible to eliminate the mechanical elements had shown that it took Dr. Cattell, on the average, .380 of a second to make an association with a concrete noun, and .508 of a second with an abstract noun; the time for an association with a verb being intermediate, .465 of a second. The abstractness of the word renders the association process difficult, this being especially evident in extreme cases. Thus, to make the association *deliverance-hope* required 1.453 seconds; *civilization-wilderness*, 1.064 seconds; while the quickest associations were *good-bad* (.111 of a second), *father-mother* (.132 of a second), and the like. Individual variation regarding the time of association is of course large, and the stage of mental development is an equally important consideration. It was found that the boys in an upper class of a German gymnasium took considerably less time to respond with associations to a given series of words than the boys in a lower class.

A somewhat different method of investigation consisted in giving simply the first word, and asking the subject to write as many suggested words as possible within 20 seconds. From this the average association time (including the very long writing time) can be calculated. This was tried with four forms of a London girls' school, with a Dublin girls' school, with some students of Bryn Mawr College, and with some London and Irish graduates. A very distinct shortening of the time accompanies the advance in form. When the average age of the pupils was 12.7 years, the average time for concrete nouns was 6.9 seconds; at 14.8 years it was 4.76 seconds; at 16.3 years, 4.26 seconds; at 17.8 years, 3.7 seconds. The corresponding time for the Bryn Mawr collegians was 3.51 seconds. The associations with abstract words require constantly more time than with concrete words, but this difference diminishes as the mental development progresses. Furthermore, the last class-rank bears a relation to rapidity of association, the highest pupils showing a quicker time, though this relation is only a general one. Some words more readily call up a series of words than others. Fatigue and a variety of factors also enter to influence the association times, but their relative worth is not affected by these disturbances.

Turning to the nature of the association, we are at once struck by the frequency with which a word suggests the same word to the minds of different persons. Four hundred and sixty-five per-

sons were given each of the following ten concrete and ten abstract words, and were required to name a suggested idea as quickly as possible; viz., *house, tree, ship, chair, clock, bird, shoe, hat, child, hand,* and *time, courage, form, virtue, art, love, strength, part, beauty, number.* Of the 4,650 "concrete" words, the ten words most frequently suggested by the ten given words form no less than 1,210, or more than one in every four. Two hundred and nineteen (or nearly one-half) responded with *finger* to the word *hand,* and 212 responded with *leaf* to the word *tree:* of the 4,650 words associated with the ten abstract words, the ten most frequent associations amount to 760 occurrences, or one in six; the most frequent associations being *good* or *goodness* with *virtue* (127 times), and *painting* with *art* (115 times).

An analysis of the associating processes here involved shows that in part they harmonize with the ordinary laws of association, but in part necessitate an extension of their interpretation. Dr. Cattell, regarding *contrast* as a variety of *similarity,* makes the latter and *contiguity in space and time* the two fundamental types of association. The latter associations are given us ready-made by sensation, and so may be termed objective or outer associations, while *similarity* may be displaced by *logical* associations. The *objective* are subdivided into *co-existence* and *succession;* the *co-existence,* into *co-ordination, whole to part,* and *part to whole;* the *succession,* into *forwards* and *backwards.* Again, the *logical* are either cases of *specification* or *causation.* The former, again, are either cases of *correlation, specialization,* or *generalization;* the latter, *final* or *efficient.* These classes are not natural kinds, nor does every association fall unambiguously into one class; but they call attention to real classes, and serve as a starting-point for further investigation. Associations occur that only by straining fall into any of the classes, associations by sounds of words (alliteration, rhyming) being an important example of these. From the tables printed in their essay, the authors conclude that with concrete nouns the link is "not quite as often supplied by thought as by sensation." *Whole to part* and *specialization* are very much more frequently used than *part to whole* and *generalization.* A comparison of the associations made by the writers and two other professional persons with those made by the pupils of several schools shows that "logical and verbal associations are favored by the first four observers, who teach and write. With the students, *whole to part* is the favorite category: they seem to visualize the object and name some part of it. . . . The largest proportion of logical associations was made by E and C, who are engaged in abstract studies." The word itself often suggests the special kind of association. Thus, "*tree* and *hand* are natural objects which are easily pictured, and have parts (leaves and fingers respectively) readily named. With *child,* on the other hand, specialization was the favorite category. Final cause was the largest class in the case of *clock,* a thing made and used for the special purpose of measuring time. Conversely, *time* often suggested the means of its measurement. Of the other abstract nouns, *art* and *number* were commonly specialized, while *courage* and *love* most frequently suggested a similar or contrasted idea."

In all such experiments the subject himself, by going over his experience just after the association, can recover the lost links which the mere statement of a word and its association would neglect. A few very suggestive appendices, founded upon such introspections, are given, that show how very complicated the associative process may be, and how very cautiously one must proceed in the discussion of them. However, these uncertainties do not seriously vitiate the value of experimental studies, and it is only by such studies that a practical insight into our mental processes can be gained. The ease with which association studies can be made should lead one to expect many valuable contributions in the near future.

THE MENTAL POWERS OF THE CHIMPANZEE. — The female chimpanzee in the Zoölogical Gardens at London, says *Nature,* has recently been made the subject of experiments by Dr. G. J. Romanes, that shed interesting light upon animal psychology. The general intelligence of the creature is very high. She understands a great many words, is ingenious in her play, and gives expression to her feelings in a variety of ways. If, instead of being constantly exposed to the distracting influences of an inquisitive public, she were carefully reared, Dr. Romanes suggests that a higher degree of mental development might be expected. The experiments began by asking the chimpanzee to hand out one, two, or three straws from her cage. If the wrong number of straws was given, they were refused; but, when the action was correct, she was rewarded with a piece of fruit. The straws were taken one by one, and held in the mouth until the requisite number was gathered. She soon learned to associate these three names with the number of straws, and unfailingly gave the right number. Then *four,* and later *five,* was added to her vocabulary. Her keeper has attempted to teach the chimpanzee to count up to ten, but with only partial success. She rarely mistakes numbers up to five, and, when asked for seven, eight, nine, or ten, understands that this means "more than five;" but the accuracy of her count does not extend further than this. Dr. Romanes thinks it possible that the creature's patience may be exhausted in these high numbers, since she has to collect the straws one by one. As evidence of this, the creature has been observed to double a straw and offer it as two, thus showing a knowledge of multiplication. The mechanism of this process is hardly that of notation, but simply the appreciation of sense-impressions such as we see in a child and in savage people. Tribes to whom "more than five" is ascribed in an indefinite "many" have been observed. Dr. Romanes has also attempted to teach the chimpanzee the names of colors by holding out two straws of different colors, and requiring her to select the color named. She learned to distinguish the white straw from any other color, but never went further. Dr. Romanes sees no reason why this distinction should be easier than any other, and so regards the failure as probably due to color-blindness.

NOTES AND NEWS.

LOCOMOTIVE engineers are inclined, it is said, to obesity.

— Gum-chewers' paralysis is the latest form of professional neurosis recorded in medical literature.

— The chemists of the United States Agricultural Department are about to begin the work of investigating the different artificial foods and infant foods now on the market.

— The will of John W. McCoy, who died in Baltimore recently, contains a bequest of $100,000 to the Johns Hopkins University. He also gives his library to this institution.

— The following appointments are announced at Clark University: Professor Arthur Michael of Tufts College, professor of chemistry; Professor J. Playfair McMurrich of Haverford College, docent in biology; Dr. Franz Boas, docent of the University of Berlin, docent in anthropology; B. C. Burt of Michigan University, docent in historical psychology; Professor Alfred Cook of Bryn Mawr College, docent in psychology; Dr. Arthur McDonald, docent in psychology; Professor Herman C. Bumpus of Olivet College, Michigan, fellow in biology.

— The English Silk Association is arranging to hold in London, next spring, an exhibition of the silk manufactures in the United Kingdom and Ireland. In order to place before the public the capabilities of the home industry for supplying its requirements, it has been decided that the exhibition should contain specimens of various branches, consisting, among others, of broad and narrow silk fabrics, including poplins, etc.; also lace, embroidery, silk hosiery, costumes, fans, trimmings, sewing and embroidery silks, twists, cords, etc.; thrown silks, Indian and British colonial raw silks, etc.; exhibits illustrative of the growth of silk, of the processes of manufacture, and of the printing, dyeing, and finishing of silk; various silk handicrafts in operation; industrial and decorative design as applied to silk fabrics.

— The recently published statistics of criminality in Germany confirm once more a fact brought out in earlier reports. For many years the character of criminal acts in that country has been undergoing a radical change: while those against property have shown a constant decrease in number, the number of crimes against life has as constantly increased. Some think they can trace a connection between an increase in the crimes against life and the increase in the use of alcoholic drinks, the greatest increase

being in Bavaria and in certain portions of Prussia where the alcohol habit has shown the greatest increase.

— Dr. Brown-Sequard is an American. His father, Capt. Edward Brown, of the American navy, was a Philadelphian, and married a French woman on the Island of Mauritius, named Sequard. He and his descendants took the name of Brown-Sequard. The distinguished scientist was the eldest child. He was educated in France, but was afterwards a professor in Harvard, and practised medicine in New York for some years after 1873. He married twice, his first wife being Miss Fletcher of Boston, a relative of Daniel Webster.

— Col. Thuillier's report on the progress of the surveys of India for the past year shows that the party employed on the trigonometrical surveys has completed the 370 miles remaining of the secondary triangulation along the east coast of India, as given in a recent number of *Engineering*. The secondary triangulation was also carried out for an aggregate length of 270 miles by parties employed in Beloochistan, as a basis for topographical surveys in that region. The work of the geodetic party comprised the measurement of seven arcs of longitude in southern India; and the tidal survey party continued its observations with self-registering tide-gauges at several stations along the coast, where tidal observatories are established, and connected with the operations of spirit-levelling. Geographical surveys have been carried out vigorously in upper Burmah, nearly 21,000 square miles having been surveyed and mapped on a half-inch scale. Reconnaissance along the Nepal boundary has supplied a rough basis for a more accurate and detailed survey of the northern frontier when an opportunity offers. Interesting additional information regarding Bhootan and Tibet has been obtained from the adventurous travels of native explorers, trained and sent thither by the department. Of the new maps, 4,062 were published during the year, and heavy demands continue to be made for transfrontier maps, and maps of upper Burmah. The photographic and lithographic offices show the large output of 1,203,861 copies during the year, including high-class illustrations for archæological and other reports.

— M. Vénukoff, writing to the *Scottish Geographical Magazine*, says, "M. Grum-Grjimaïlo has commenced his journey in Central Asia, starting from Vernoï. His first letter, dated from Jarkent, on the Russo-Chinese frontier in Dzungaria, appeared in the Russian journal *Novosti* for July 6, 1889. It informs us that the season of spring was this year late in Dzungaria, and that the lower limit of snows on the Ala Tau Mountains reached in the month of May to an elevation above the sea-level of 7,874 feet, which was very low for that season of the year in the latitude of 43° north, and under the brilliant sky of Central Asia. The Ili and all other rivers of the region were greatly increased by the melting of the snows in June. M. Grum-Grjimaïlo will continue his journey in the Chinese provinces adjoining the Thian Shan; but it is expected that the Chinese authorities will place obstacles in his way, from the fact of his being unprovided with a passport from the Tsung-li-yamen of Peking. But if he succeeds, he will establish a precedent for all future explorers. I should add, that quite recently Jarkent has suffered greatly from a violent earthquake, but it appears that this occurred after M. Grjimaïlo's departure. Col. Pevtzov reached Yarkhand towards the end of May. At about the same time, Capt. Grombtchevsky was on the Pamir, in the neighborhood of Daraout-Kourgan, whence he was to have made his way to Chougnan; but, the latter country having been again occupied by the Afghans, I do not know whether the explorer will venture to enter it." The ethnographical map prepared by M. Vénukoff in 1883, he has now brought up to date, showing the distribution of the populations in the interesting and important district of Vladivostok. The region represented is, roughly, bounded on the west by Manchuria, on the north by latitude 45° north, and a little beyond, on the east, by longitude 135° east, and on the south by the sea. Within this territory there was, in 1888, a population numbering 55,600, of whom 35,000 were Russians, 10,000 Coreans, 9,500 Chinese, 500 Japanese, 500 Goldis and Orotchis, and 100 Europeans. Among the Chinese there were nearly 1,000 nomads; the Goldis and Orotchis are also nearly all nomads (hunters and fishers). The Europeans and the Japanese inhabit Vladivostok. The Coreans are all sedentary, and they inhabit the large villages; while the Chinese are dispersed about the country, noticeably in communities (farms) settled along the eastern river-courses. The principal centre of population is of course Vladivostok (13,000 inhabitants); then come Nicolskoé, Novo-Kief, and Kamen-Rybolov. There are in the Russian villages 9 *stanitzas* occupied by 2,877 Cossacks, whose duty it is to guard the frontier between Lake Hankaï and the mouth of the Toumen-oula.

— A French military writer writes in the *République Française* as follows on the subject of melinite. His remarks are interesting but should be accepted with a considerable amount of reserve. "Our shells for field artillery, as well as those for our forts and siege-guns, are charged with melinite. What melinite is, we do not know, and if we knew we should be very careful not to tell Both the Italians and the Germans have sent spies to discover the secret, and to offer money for even the smallest fragment, but they have all been captured. All that can be said is, that, according to a treatise published in 1882, melinite is composed of melted picric acid. But in the interval our artillerists have perfected the discovery of M. Turpin. They have made melinite a tractable product. The effects of this explosive were fully demonstrated at some experiments at the Fort of Malmaison in 1886. Melinite is so safe, that in three years only one accident has occurred, that at the arsenal of Belfort. On the other hand, a hundred accidents have occurred from gelatine alone in thirty years. There has never been an accident in drawing the charges, nor one from bursting in the gun. As much cannot be said for roburite, hellofite, or the other substances employed by foreign States. What will become of a fortification in face of this redoubtable agent? Some think and say they are doomed; others, like Gen. Brialmont, recommend the use of armored circular forts. It is said that the shell will glance off these without doing any damage; but experiments at Chalons have shown that turrets enjoy no immunity against a close and continuous fire."

— Those living in a locality in which the mosquitoes are troublesome, says the *Annals of Hygiene*, may make a trial of the following recipe for expelling these pests from the house: take a piece of gum-camphor, in size about the third of a hen's egg, and slowly evaporate it by holding it in a shovel or tin vessel over a lamp, taking care that it does not ignite. The smoke will soon fill the room and expel the mosquitoes, and it is said they will not return, even though the windows should be left open all night.

— The following resolutions were adopted by the international congress on hypnotism held in Paris last month: 1. Public exhibitions of hypnotism or magnetism should be forbidden by government; 2. The use of hypnotism as a therapeutic agent should be restricted to practising physicians; 3. It is to be hoped that the method and practice of hypnotism will be included in the medical education of students.

— Recognizing the difficulty that is experienced in keeping fire-pails constantly full, an American inventor has proposed to cover the pail with an air-tight sheet of tinfoil, which, while preventing the contents from evaporating, can, when wanted, be easily broken through by the hand. In order to anticipate the almost equal difficulties that may arise from the freezing of the contents, brine, or some similar liquid, may be used for filling the pails, in place of water.

— Sibley College is to have a tremendous class this year. The college will be crowded by 350 or 400 students where they were only really desirous of handling 200, the limit set four years ago as the maximum number that they were likely to find satisfactory room for. Cornell University will have a class somewhere between 425 and 450, and a total in all branches and classes of about 1,300, perhaps 1,400. They can again boast the largest freshman class entering any American university.

— It is reported from Japan (*Nature*, Sept. 12), that Viscount Ennomoto, the new minister of education, is devoting special attention to the introduction of technical education into the primary schools of the empire, and that he has turned to Italy as a model. His scheme is to include technical education in the curriculum of the preparatory schools, and to give children technical training from the outset.

— At the July meeting of the Anthropological Society of Bombay, Mr. Kitts of the Indian Civil Service read a paper on the early history of northern India, in which the theory recently put forward by Mr. Hewitt, on the early history of India, was stated and discussed. The theory of Mr. Hewitt, as stated in *Nature*, is briefly this: that the first immigrants who settled in India, and have left traces surviving, were the so-called Kolarian races, who came from the north-east; and that their descendants, to the number of ten millions or thereabouts, are still occupants of northern India. The Kolarians were succeeded and conquered by the Dravidians, who came from the north-west, and developed in India a very high state of civilization, both social and political. Large estates belonged to single owners, such as the *talukdari* tenures in northern India, and the *zemindari* and *patidari* tenures in southern India. "In short," says Mr. Hewitt, "it was the Dravidians who founded and consolidated the present land-revenue system of India." The Dravidians also organized the *punchayet* and *chowkidar* system of village government, which has survived to the present day. All the manual arts and industries practised in the India of to-day were known to and practised by the Dravidians. The Aryans, migrating into a land occupied as India then was by the Dravidians, with a strongly organized system of government, found great difficulty in obtaining a foothold, and, even when they had secured a tract of country in the north-west for themselves, did not obtain supremacy over the rest of India by force of arms. The agents of their subsequent advance were three, — religion, commerce, and military ability. Friendly alliances were concluded between the new-comers and the snake races of the Dravidians. The Aryans admitted the noble races of the Dravidians to be of royal blood, and accepted Siva or Lingam worship as not dishonoring to their religion. The Dravidians, thus recognized as of noble blood, were the ancestors of the modern Rajpoots and the Kshatriya caste. Intellectually the Aryans were far superior to the Dravidians, and the Aryan tongue was accordingly adopted as the *lingua franca* for commercial purposes. So, too, the Aryan became a necessary element in every court and in every commercial enterprise, and from this time forward (about six centuries B.C.) their supremacy was assured.

— According to *Nature*, Dr. Rudolph Koenig, the well-known constructor of standard acoustical apparatus in Paris, has just made a discovery of extreme importance in the theory of music, the details of which he will expound at the forthcoming meeting of the Naturforscher at Heidelberg. This is an extension of Helmholtz's theory of timbre to certain cases not represented in the elementary mathematical theory, and corresponding to the actual case of the timbres of certain musical instruments. The paper is certain to give rise to discussion, and will be of interest to musicians, who have never, as is notorious, taken kindly to Helmholtz's theory in its original form.

— Mr. Gustave Guttenberg, formerly of Erie, Penn., who is conducting the Agassiz course of mineralogy, has accepted the position of teacher of biology in the Central High School at Pittsburgh, Penn., and desires his correspondents to take notice of the change of his address.

— The following topics have been selected for consideration at the seventeenth annual meeting of the American Public Health Association, Brooklyn, to be held Oct. 22–25: "The Causes and Prevention of Infant Mortality;" "Railway Sanitation," — (*a*) "Heating and Ventilation of Railway Passenger-Coaches," (*b*) "Water-Supply, Water-Closets, etc.," (*c*) "Carrying Passengers Infected with Communicable Diseases;" "Steamship Sanitation;" "Methods of Scientific Cooking;" "Yellow-Fever," — "(*a*) "The Unprotected Avenues through which Yellow-Fever is Liable to be brought into the United States," (*b*) "The Sanitary Requirements necessary to render a Town or City Proof against an Epidemic of Yellow-Fever," (*c*) "The Course to be taken by Local Health Authorities upon the Outbreak of Yellow-Fever;" "The Prevention and Restriction of Tuberculosis in Man;" "Methods of Prevention of Diphtheria, with Results of such Methods;" "How far should Health Authorities be permitted to apply known Preventive Measures for the Control of Diphtheria;" "Compulsory Vaccination;" and "Sanitation of Asylums, Prisons, Jails, and other Eleemosynary Institutions." Addresses of welcome will be delivered by Hon. Alfred C. Chapin, mayor, on behalf of the city, and by Alexander Hutchins, M.D., on behalf of the medical profession.

— Dr. George H. Cook, the New Jersey State geologist, and vice-president of Rutgers College, died Sept. 22, at New Brunswick, of heart-failure. Dr. Cook was taken ill Saturday noon, but his illness was not considered at all serious, and his death was totally unexpected. His work as State geologist has been varied and of great importance. The topographical maps of the State which have been published under his supervision have been among the best of any published by the different States. The last of the series was recently issued, and Dr. Cook was at the time of his death engaged on his final report. Two volumes had been prepared, the latter now being in print. He was seventy-two years of age, and leaves a widow and two children, — one son and one daughter.

— Among the recent scientific missions undertaken by order of the French Government, says *Nature*, are one by Professor Viault of Bordeaux, in the tablelands of Peru, Eucador, and Bolivia, to continue the investigations of the late M. Paul Bert into rarefied air; one by M. de Coubertin, secretary of the committee for the encouragement of physical exercises in education in the United States and Canada, to visit the universities and colleges, to study the working of the various athletic associations frequented by the young people of these countries; one by M. Jacques de Morgan, mining engineer, to explore those parts of Asia Minor lying between the south of the Caspian Sea, Armenia, the Gulf of Alexandria, and Anti-Taurus (this mission will occupy two years and three months); and one by M. Candelier, to Colombia, to make ethnographical researches and collections for the State.

— Exactly a century ago — namely, in 1789 — Klaproth succeeded in isolating from a dark-colored mineral known as pitchblende a yellow oxide, which, after carefully testing, he pronounced to be the oxide of a new metal. To this metallic substance he gave the name of "uranium," so calling it after the planet Uranus, then recently discovered by Herschel; and it was at once classed among the rare metals, and still remains so. Its rarity is indicated by its market price, which is about $12,000 per ton. There are several oxides of this metal; but the best known and most important is the sesquioxide, which forms a number of beautiful yellow salts. This oxide is largely employed for imparting delicate golden and greenish yellow tints to glass, while the protoxide is much used in producing the costly black porcelain. Uranium is also found to be useful in certain photographic processes as a substitute for the chloride of gold; but its rarity and consequent high price have hitherto caused its application to be very limited, although there are uses other than those already named to which it could be put if it were less scarce and less costly. It is found in Cornwall, Saxony, and Bohemia; but up to the present time it has only been met with in isolated pockets and patches. The centenary of its discovery by Klaproth has, however, according to the *London Times*, been marked by the finding of a continuous lode at the Union Mine, Grampound Road, Cornwall, which is believed to be the only known lode in the world. This discovery is regarded as unique in the history of the metal; for the lode is what is known as a true fissure-vein, and the ore is found to contain an average of twelve per cent of the pure metal, the assays going up as high as thirty per cent in some parts of the lode. Several tons of the ore have already been raised and sold, fetching high prices. The lode traverses the mine from north to south, and the uranium occurs in it chiefly as a sesquioxide. It is anticipated that the present discovery will enable two important applications of the metal to be followed up. The first is as a substitute for gold in electro-plated ware, inasmuch as with platinum and copper it forms two beautiful alloys, each having the appearance of gold, and the former also resisting the action of acids. The second application is in connection with electric installations, where its usefulness consists in its high electrical resistance. The mineral deposits generally at the Union Mine are of an exceptional character, comprising, in addition to uranium, magnetic iron, silver, lead, tin, copper, ochre, and umber.

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THE COMMITTEE ON SITES for the world's fair in New York in 1892 has recommended that the upper part of Central Park be taken for the purpose, to which shall be added some outlying unoccupied land. The point of special interest just now is that a considerable portion of the New York community object to any part of the park being used, maintaining that the upper portions are the most attractive of all, and, as is freely acknowledged by all, that these will have to be denuded of trees and scraped down to a more level surface by the city contractors, so as to ruin their beauty for a generation to come. It is to be said, also, that the lower parts of the park would be turned practically into little more than an entrance to the fair-grounds proper, thus depriving them of the character which draws so many to them on all holidays. The scheme has its advocates, however; and it is of course true that a part of its support is to be traced to the interests of real-estate owners, as would be the case if any other site were chosen, only here, the interests being the greater, the support is the more earnest.

MODERN PHOTOGRAPHY.[1]

THE occupant of this chair has a difficult task to perform, should he attempt to address himself to all the various subjects with which this section is supposed to deal. I find that it has very often been the custom that some one branch of science should be touched upon by the president; and I shall, as far as in me lies, follow this procedure.

This year is the jubilee of the practical introduction of photography by Daguerre and Fox Talbot, and I have thought I might venture to take up your time with a few remarks on the effect of light on matter. I am not going into the history of photography, nor to record the rivalries that have existed in regard to the various discoveries that have been made in it. A brand-new history of photography, I dare say, would be interesting, but I am not the person to write one; and I would refer those who desire information as to facts and dates to histories which already exist. In foreign histories perhaps we English suffer from speaking and writing in a language which is not understanded of the foreign people; and the credit of several discoveries is sometimes allotted to nationalities who have no claim to them. Be that as it may, I do not propose to correct these errors or to make any reclamations. I leave that to those whose leisure is greater than mine.

I have often asserted, and I again assert, that there should be no stimulus for the study of science to be compared to photography. Step by step, as it is pursued, there will be formed a desire for a knowledge of all physical science. Physics, chemistry, optics, and mathematics are all required to enable it to be studied as it should be studied; and it has the great advantage that experimental work is the very foundation of it, and results of some kind are always visible. I perhaps am taking an optimist view of the matter, seeing there are at least twenty-five thousand living facts against my theory, and perhaps not one per cent of them in its favor. I mean that there are at least twenty-five thousand persons who take photographs, and scarcely one per cent who know or care anything of the "why or wherefore" of the processes, so far as theory is concerned. If we call photography an applied science, it certainly has a larger number who practise it, and probably fewer theorists, than any other.

He would be a very hardy man who would claim for Niépce, Daguerre, or Fox Talbot the discovery of photographic action on matter. The knowledge that such an action existed is probably as old as the fair-skinned races of mankind, who must have recognized the fact that light, and particularly sunlight, had a tanning action on the epidermis; and the women, then as now, no doubt took their precautions against it. As to what change the body acted upon by light underwent, it need scarcely be said that nothing was known; and perhaps the first scientific experiment in this direction was made rather more than a hundred years ago by Scheele, the Swedish chemist, who found, that, when chloride of silver was exposed to light, chlorine was given off. It was not till well in the forties that any special attention was given to the action that light had on a variety of different bodies; and then Sir John Herschel, Robert Hunt, Becquerel, Draper, and some few others, carried out experiments which may be termed "classical." Looking at the papers which Herschel published in the "Philosophical Transactions" and elsewhere, it is not too much to say that they teem with facts which support the grand principle that without the absorption of radiation no chemical action can take place on a body: in other words, we have in them experimental proofs of the law of the conservation of energy. Hunt's work, "Researches on Light," is still a text-book to which scientific photographers refer, and one is sometimes amazed at the amount of experimental data which is placed at our disposal. The conclusions that Hunt drew from his experiments, however, must be taken with caution in the light of our present knowledge, for they are often vitiated by the idea which he firmly held, that radiant heat, light, and chemical action, or actinism, were each of them properties, instead of the effects, of radiation. Again: we have to be careful in taking seriously the experiments carried out with light of various colors when such colors were produced by absorbing media. It must be remembered that an appeal to a moderately pure spectrum is the only appeal which can be legitimately made as to the action of the various components of radiation, and even then the results must be carefully weighed before any definite conclusion can be drawn. No photographic result can be considered as final unless the experiments be varied under all the conditions which may possibly arise. Colored media are dangerous as enabling trustworthy con-

[1] Address of Capt. W. De W. Abney, president of the section of mathematics and physics, of the British Association for the Advancement of Science, delivered before the association at its meeting recently (from *Nature*).

clusions to be drawn, unless the characters of such media have been thoroughly well tested, and the light they transmit has been measured. An impure spectrum is even more dangerous to rely upon, since the access of white light would be sure to vitiate the results.

Perhaps one of the most puzzling phenomena to be met with in photography is the fact that the range of photographic action is spread over so large a portion of the spectrum. The same difficulty, of course, is felt in the matter of absorption, since the one is dependent on the other. Absorption by a body we are accustomed, and indeed obliged by the law of the conservation of energy, to consider as due to the transferrence of the energy of the ether wave-motion to the molecules and atoms comprising the body by increasing the vibrations of one or both.

In the case where chemical action takes place, we can scarcely doubt that it is the atoms which in a great measure take up the energy of the radiation falling on them, as chemical action is dependent on the liberation of one or more atoms from the molecule; while, when the swings of the molecules are increased in amplitude, we have a rise in temperature of the body. I shall confine the few remarks I shall make on this subject to the case of chemical action. The molecule of a silver salt, such as bromide of silver, chemists are wont to look upon as composed of a limited and equal number of atoms to form the molecule. When we place a thin slab of this material before the slit of the spectroscope, we find a total absorption in the violet and ultra-violet of the spectrum, and a partial absorption in the blue and green, and a diminishing absorption in the yellow and red. A photographic plate containing this same salt is acted upon in exactly the same localities and in the same relative degree as where the absorption takes place. Here, then, we have an example of, it may be, the vibrations of four atoms, one of which at least is isochronous, or partially so, with the waves composing a large part of the visible spectrum. The explanation of this is somewhat obscure. A mental picture, however, may help us. If we consider that, owing to the body acted upon being a solid, the oscillations of the molecules and atoms are confined to a limited space, it probably happens that between the times in which the atoms occupy, in regard to one another, the same relative positions, the component vibrations of, say, two of the atoms vary considerably in period. An example of what I mean is found in a pendulum formed of a bob and an elastic rod. If the bob be made to vibrate in the usual manner, and at the same time the elastic rod be elongated, it is manifest that we have a pendulum of ever-varying length. At each instant of time the period of vibration would differ from that at the next instant, if the oscillations were completed. It is manifest that increased amplitude would be given to the pendulum-swings by a series of well-timed blows differing very largely in period. At the same time there would be positions of the pendulum in which some one series of well-timed blows would produce the greatest effect. In a somewhat similar manner we should imagine that the ethereal waves should produce increased amplitude in the swing of the atoms between very wide limits of period, and, further, that there should be one or more positions in the spectrum when a maximum effect is produced. I would here remark that the shape of the curves of sensitiveness, when plotted graphically, of the different salts of silver to the spectrum, have a marked resemblance to the graphically drawn curves of the three color-sensations of the normal eye, as determined by Clerk Maxwell. May not the reason for the form of the one be equally applicable for the other? I only throw this out as evidence, not conclusive indeed, that the color-sensitiveness of the eye is more probably due to a photographic action on the sensitive retina than to a merely mechanical action. That this is the case, I need scarcely say has several times been propounded before.

The ease with which a silver salt is decomposed is largely, if not quite, dependent on the presence of some body which will take up some of the atoms which are thrown off from it: for instance, in chloride of silver we have a beautiful example of the necessity of such a body. In the ordinary atmosphere the chloride is, of course, colored by the action of light; but if it be carefully dried and purified, and placed in a good vacuum, it will remain uncolored for years in the strongest sunlight. In this case the absence of air and moisture is sufficient to prevent it discoloring.

If in the vacuum, however, a drop of mercury be introduced, the coloration by light is set up. We have the chlorine liberated from the silver and combining with the mercury vapor, and a minute film of calomel formed on the sides of the vessel.

Delicate experiments show that not only is this absorbent almost necessary when the action of light is so strong or so prolonged that its effect is visible, but also when the exposure or intensity is so small that the effect is invisible and only to be found by development. The reason for this absorbent is not far to seek. If, for instance, silver chloride be exposed to light *in vacuo*, although the chlorine atoms may be swung off from the original molecule, yet they may only be swung off to a neighboring molecule which has lost one of its chlorine atoms, and an interchange of atoms merely takes place. If, however, a chlorine absorbent be present which has a greater affinity for chlorine than has the silver chloride which has lost one of its atoms, then we may consider that the chlorine atoms will be on the average more absorbed by the absorbent than by the subchloride molecules. The distribution of the swung-off atoms between the absorbent and the subchloride will doubtless be directly proportional to their respective affinities for chlorine, and so for the other salts of silver. If this be so, then it will be seen that the greater the affinity of the absorbent for the halogen, the more rapid will be the decomposition of the silver salt. This, then, points to the fact that if any increase in the sensitiveness of a silver salt is desired, it will probably be brought about by mixing with it some stronger halogen absorbent than has yet been done.

The question as to what is the exact product of the decomposition of a silver salt by the action of light is one which has not as yet been fully answered. For my own part, I have my strong beliefs and my disbeliefs. I fully believe the first action of light to be a very simple one, though this simple action is masked by other actions taking place, due to the surroundings in which it takes place. The elimination of one atom from a molecule of a silver salt leaves the molecule in an unsatisfied condition, and capable of taking up some fresh atom. It is this capacity which seemingly shrouds the first action of light, since when exposure is prolonged the molecules take up atoms of oxygen from the air or from the moisture in it. Carey Lea of Philadelphia has within the last three years given some interesting experiments on the composition of what he calls the photochloride of silver, which is the chloride colored by light, and Professor Hodgkinson has also taken up the matter. The conclusions the former has drawn are, to my mind, scarcely yet to be accepted. According to the latter experimentalist, the action of light on silver chloride is to form an oxidized subsalt. This can hardly be the case, except under certain conditions, since a colored compound is obtained when the silver chloride is exposed in a liquid in which there is no oxygen present.

This coloration by light of the chloride of silver naturally leads our thoughts to the subject of photography in natural colors. The question is often asked when photography in natural colors will be discovered. Photography in natural colors not only has been discovered, but pictures in natural colors have been produced. I am not alluding to the pictures produced by manual work, and which have from time to time been foisted on a credulous public as being produced by the action of light itself, much to the damage of photography, and usually of the so-called inventors. Roughly speaking, the method of producing the spectrum in its natural colors is to chlorinize a silver plate, expose it to white light till it assumes a violet color, heat till it becomes rather ruddy, and expose it to a bright spectrum. The spectrum colors are then impressed in their natural tints. Experiment has shown that these colors are due to an oxidized product being formed at the red end of the spectrum, and a reduced product at the violet end. Photography in natural colors, however, is only interesting from a scientific point of view, and, so far as I can see, can never have a commercial value. A process, to be useful, must be one by which reproductions are quickly made: in other words, it must be a developing and not a printing process, and it must be taken in the camera; for any printing process requires not only a bright light, but also a prolonged exposure. Now, it can be conceived that in a substance which absorbs all the visible spectrum the molecules can be so shaken and sifted by the different rays, that eventually they sort themselves into masses which reflect the particular rays by which

they are shaken; but it is almost — I might say, quite — impossible to believe that when this sifting has only been commenced, as it would be in the short exposure to which a camera picture is submitted, the substance deposited to build up the image by purely chemical means would be so obliging as to deposit in that the particular size of particle which should give to the image the color of the nucleus on which it was depositing. I am aware that in the early days of photography we heard a good deal about curious results that had been obtained in negatives, where red brick houses were shown as red, and the blue sky as bluish. The cause of these few coincidences is not hard to explain, and would be exactly the same as when the red brick houses were shown as bluish, and the sky as red, in a negative. The records of the production of the latter negatives are naturally not abundant, since they would not attract much attention. I may repeat, then, that photography in natural colors by a printing-out process — by which I mean by the action of light alone — is not only possible, but has been done, but that the production of a negative in natural colors from which prints in natural colors might be produced, appears, in the present state of our knowledge, to be impossible. Supposing it were not impracticable, it would be unsatisfactory, as the light with which the picture was impressed would be very different from that in which it would be viewed. Artists are fully aware of this difficulty in painting, and take their precautions against it.

The nearest approach to success in producing colored pictures by light alone is the method of taking three negatives of the same subject through different-colored glasses, complementary to the three color-sensations which together give to the eye the sensations of white light. The method is open to objection on account of the impure color of the glasses used. If a device could be adopted whereby only those three parts of the spectrum could be severally used which form the color-sensations, the method would be more perfect than it is at present. Even then, perfection could not be attained, owing to a defect which is inherent in photography, and which cannot be eliminated. This defect is the imperfect representation of gradation of tone. For instance: if we have a strip graduated from what we call black to white (it must be recollected that no tone can scientifically be called black, and none white), and photograph it, we shall find that in a print from the negative the darkness which is supposed to represent a gray of equal mixtures of black and white by no means does so unless the black is not as black nor the white as white as the original. The cause of this untruthfulness in photography has occupied my attention for several years, and it has been my endeavor to find out some law which will give us the density of a silver deposit on a negative corresponding with the intensity of the light acting. I am glad to say that at the beginning of this year a law disclosed itself, and I find that the transparency of a silver deposit caused by development can be put into the form of the law of error.

This law can be scarcely empiric, though at first sight it appears that the manipulations in photography are so loose that it should be so. It is this very looseness, however, which shows that the law is applicable, since in all cases I have tried it is obeyed. That there are theoretical difficulties cannot be denied, but it is believed that strictly theoretical reasoning will eventually reconcile theory with observation.

This want of truth in photography in rendering gradation, then, puts it out of the range of possibility that photography in natural colors can ever be exact, or that the three-negatives system can ever get over the difficulty.

One of the reproaches that in early days was cast at photography was its inability to render color in its proper monochromatic luminosity. Thus, while a dark blue was rendered as white in a print (that is, gave a dense deposit in a negative), bright yellow was rendered as black in a print, or nearly so (that is, as transparent or nearly transparent glass in the negative). To the eye the yellow might be far more luminous than the blue, but the luminosity was in the photograph reversed. I need scarcely say that the reason of this want of truth in the photograph is due to the want of sensitiveness of the ordinarily used silver salts to the least refrangible end of the spectrum. Some fifteen years ago Dr. H. W. Vogel announced the fact that when silver salts were stained with certain dyes they became sensitive to the color of the spectrum, which the dyes absorbed. This at once opened up possibilities, which, however, were not at once realized, owing perhaps to the length of exposure required when the collodion process was employed. Shortly after the gelatine process was perfected, the same dyes were applied to plates prepared by this method, which, although they contained the same silver salts as the old collodion process, yet *per se* were very much more sensitive. A new era then dawned for what has been termed "isochromatic" and "orthochromatic" photography. The dyes principally used are those belonging to the eosine group and cyanine; not the ordinary cyanine dye of commerce, but that discovered by Greville Williams. For a dye to be of use in this manner, it may be taken as an axiom — first propounded by the speaker, it is believed — that it must be fugitive, or that it must be capable of forming a silver compound. The more stable a dye is, the less effective it is. If we take as an example cyanine, we find that it absorbs in the orange and slightly in the red. If paper or collodion stained with this coloring-matter be exposed to the action of the spectrum, it will be found that the dye bleaches in exactly the same part of the spectrum as that in which it absorbs, following, indeed, the universal law I have already alluded to. If a film containing a silver salt be dyed with the same, it will be found, that, while the spectrum acts on it in the usual manner, — viz., darkening it in the blue, violet, and ultra-violet, — the color is discharged where the dye absorbs, showing that in one part of the spectrum it is the silver salt which is sensitive, and that in the other it is the coloring-matter. If such a plate, after exposure to the spectrum, be developed, it will be found that at both parts a deposit of silver takes place; and, further, when the experiment is carefully conducted, if a plate with merely cyanine-colored collodion be exposed to the spectrum and bleached in the orange, and after removal to the dark-room another film containing a silver salt be applied, and then a developer, a deposit of silver will take place where the bleaching has occurred. This points to the fact that the molecules of a fugitive dye, when altered by light, are unsatisfied, and are ready to take up an atom or atoms of silver; and other molecules of silver will deposit on such nuclei by an action which has various names in physical science, but which I do not care to mention. This is the theory which I have always advocated; viz., that the dye by its reduction acts as a nucleus on which a deposit of silver can take place. It met with opposition; a rival theory which makes the dye an "optical sensitizer" — an expression which is capable of a meaning which I conceive contrary to physical laws — being run against it. The objection to what I may call the nucleus theory is less vigorous than it has been, and its diminution is due, perhaps, to the more perfect understanding of the meaning of each other by those engaged in the controversy. To my mind, the action of light on fugitive dyes is one of the most interesting in the whole realm of photography, as eventually it must teach us something as to the structure of molecules, and add to the methods by which their coarseness may be ascertained. Be the theory what it may, however, a definite result has been attained, and it is now possible to obtain a fair representation of the luminosity of colors by means of dyed films. At present the employment of colored screens in front of the lens, or on the lens itself, is almost an essential in the method, when daylight is employed; but not till some dye is discovered which shall make a film equally sensitive for the same luminosity to the whole visible spectrum will it be possible to make orthochromatic photography as perfect as it can be made. The very fact that no photograph of even a black and white gradation will render the latter correctly, must of necessity render any process imperfect, and hence in the above sentence I have used the expression "as perfect as it can be made."

The delineation of the spectrum is one of the chief scientific applications to which photography has been put. From very early days the violet and ultra-violet end of the spectrum have been favorite objects for the photographic plate. To secure the yellow and red of the spectrum was, however, till of late years, a matter of apparently insurmountable difficulty; while a knowledge of that part of the spectrum which lies below the red was only to be gained by its heating effect. The introduction of the gelatine process enabled the green portion of the spectrum to impress itself on the sensitive surface; while the addition of various dyes, as before mentioned, allowed the yellow, the orange, and a portion of the red

rays to become photographic rays. Some eight years ago it was my own good fortune to make the dark infra-red rays impress themselves on a plate. This last has been too much a specialty of my own, although full explanations have been given of the methods employed. By preparing a bromide-of-silver salt in a peculiar manner, one is able so to modify the molecular arrangement of the atoms that they answer to the swings of those waves which give rise to these radiations. By employing this salt of silver in a film of collodion or gelatine, the invisible part of the spectrum can be photographed, and the images of bodies which are heated to less than red heat may be caused to impress themselves upon the sensitive plate. The greatest wave-length of the spectrum to which this salt is sensitive, so far, is 22,000 λ, or five times the length of the visible spectrum. The exposure for such a wave-length is very prolonged; but down to a wave-length of 12,000 it is comparatively short, though not so short as that required for the blue rays to impress themselves on a collodion plate. The color of the sensitive salt is a green-blue by transmitted light. It has yet to be determined whether this color is all due to the coarseness of the particles, or to the absorption by the molecules. The fact that a film can be prepared which by transmitted light is yellow, and which may be indicative of color due to fine particles, together with an absorption of the red and orange, points to the green color being probably due to absorption by the molecules. We have thus in photography a means of recording phenomena in the spectrum from the ultra-violet to a very large wave-length in the infra-red, — a power which physicists may some day turn to account. It would, for instance, be a research worth pursuing to photograph the heavens on a plate prepared with such a salt, and search for stars which are nearly dead or newly born; for in both cases the temperature at which they are may be such as to render them below red-heat, and therefore invisible to the eye in the telescope. It would be a supplementary work to that being carried out by the brothers Henri, Common, Roberts, Gill, and others, who are busy securing photographic charts of the heavens in a manner which is beyond praise.

There is one other recent advance which has been made in scientific photography to which I may be permitted to allude; viz., that, from being merely a qualitative recorder of the action of light, it can now be used for quantitative measurement. I am not now alluding to photographic actinometers, such as have been brought to such a state of perfection by Roscoe, but what I allude to is the measurement and interpretation of the density of deposit in a negative. By making exposures of different lengths to a standard light, or to different known intensities of light, on the same plate on which a negative has to be taken, the photographic values of the light acting to produce the densities on the different parts of the developed image can be readily found. Indeed, by making only two different exposures to the same light, or two exposures to two different intensities of light, and applying the law of density of deposit in regard to them, a curve is readily made from which the intensities of light necessary to give the different densities of deposit in the image impressed on the same plate can be read off. The application of such scales of density to astronomical photographs, for example, cannot but be of the highest interest, and will render the records so made many times more valuable than they have hitherto been. I am informed that the United States astronomers have already adopted the use of such scales, which for the last three years I have advocated, and it may be expected that we shall have results from such scaled photographs which will give us information which would before have been scarcely hoped for.

One word as to a problem which we may say is as yet only qualitatively and not quantitatively solved. I refer to the interchangeability of length of exposure for intensity of light. Put it in this way. Suppose that with a strong light, L, a short exposure, E, being given, a chemical change, C, is obtained: will the same change, C, be obtained if the time is only an nth of the light, L, but n times the exposure? Now, this is a very important point, more particularly when the body acted upon is fairly stable; as, for instance, some of the water-color pigments, which are known to fade in sunshine, but might not be supposed to do so in the light of an ordinary room, even with prolonged exposure. Many experiments have been made at South Kensington as regards this, more especially with the salts of silver; and it is found, that, for any ordinary light, intensity and exposure are interchangeable, but that when the intensity of light is very feeble, say the $\frac{1}{1000000}$ of ordinary daylight, the exposure has to be rather more prolonged than it should be supposing the exact interchangeability always held good. But it has never been found that a light was so feeble that no action could take place. Of course, it must be borne in mind that the stability of the substance acted upon may have some effect; but the same results were obtained with matter which is vastly more stable than the ordinary silver salts. It may be said, in truth, that almost all matter which is not elemental is in time, and to some degree, acted upon by light.

I should like to have said something regarding the action of light on the iron and chromium salts, and so introduced the subject of platinotype and carbon printing, the former of which is creating a revolution in the production of artistic prints. I have, however, refrained from so doing, as I felt that the president of Section A should not be mistaken as the president of Section B. Photogravure and the kindred processes were also inviting subjects on which to dwell, more especially as at least one of them is based on the use of the same material as that on which the first camera picture was taken by Niépce. Again, a dread of trenching on the domains of art restrains me.

Indeed, it would have been almost impossible, and certainly impolitic, in the time which an address should occupy, to have entered into the many branches of science and art which photography covers. I have tried to confine myself to some few advances that have been made in its theory and practice.

The discovery of the action of light on silver salts is one of the marvels of this century, and it is difficult to overrate the bearing it has had on the progress of science, more especially physical science. The discovery of telegraphy took place in the present reign, and two years later photography was practically introduced; and no two discoveries have had a more marked influence on mankind. Telegraphy, however, has had an advantage over photography in the scientific progress that it has made, in that electrical currents are subject to exact measurement, and that empiricism has no place with it. Photography, on the other hand, has labored under the disadvantage, that, though it is subject to measurement, the factors of exactitude have been hitherto absent. In photography we have to deal with molecules the equilibrium of whose components is more or less indifferent according to the process used. Again, the light employed is such a varying factor that it is difficult to compare results. Perhaps more than any other disadvantage it labors under, is that due to quackery of the worst description at the hands of some of its followers, who not only are self-asserting, but often ignorant of the very first principles of scientific investigation. Photography deserves to have followers of the highest scientific calibre; and, if only some few more real physicists and chemists could be induced to unbend their minds and study the theory of an applied science which they often use for record or for pleasure, we might hope for some greater advance than has hitherto been possible.

Photography has been called the handmaid of art: I venture to think it is even more so the handmaid of science, and each step taken in perfecting it will render it more worthy of such a title.

ELECTRICAL NEWS.

Recent Fatalities from Electricity.

ONE death and several serious injuries from electric-light wires have occurred during the past two weeks. Some days ago the eight-year-old son of Charles Kern of Baltimore came in contact with an electric-light wire while looking out of a window, lost his balance, and fell to the street. A New York daily newspaper, alluding to the fact, stated that the boy was "fairly lifted out of the room, and hurled into the street;" all of which is interesting, if true. John Powers, an employee of The Brush Electric-Light Company, thoughtlessly took hold of a live wire with one hand, and with the other made an excellent ground connection with the Elevated Railroad structure on East 34th Street. He was standing on a step-ladder at the time; and the shock of the fall, not the current, killed him. Some days after this occurrence a poor vagrant,

while standing on a curbstone, was struck a light tap by a coil of dead wire which a lineman dropped from a telegraph-pole. After considering the subject for some minutes, he concluded he had received a dangerous electric shock, and communicated the fact to the lineman and various passers-by. A medical examination showed no injuries from electricity.

With regard to these accidents, which as a rule receive sensational and exaggerated notice in the daily papers, it should not be forgotten that two connections with the body are always necessary for an electric shock; the "deadly wire" being of course one, while the other is the damp surface of the sidewalk, ground, a wet telegraph-pole, or other conductor. A person touching a live wire with no other electrical connection would feel nothing; neither would there be any perceptible shock should he stand upon dry boards or other insulated or insulating material.

Another thing to be borne in mind is that writers of sensational articles regarding electrical accidents, like all reporters, make up two or three columns of such matter more with regard to interest than accuracy, for the reason that the managing editor of the paper in which they appear will receive them, and the writers will be rewarded at the rate of from four to eight dollars per column for their work.

According to one of these articles in a New York daily, Mayor Grant is said to believe that the only way wholly to prevent accidents of this kind is by burying the wires, and that, when this shall be done, "there will be no more deaths resulting from people coming accidentally in contact with electric currents of sufficient force to render medical assistance useless." No doubt, many of the accidents already reported would never have occurred had the wires been under ground; but, as ex-Mayor Hewitt said before the National Electric-Light Association in 1888, "Gentlemen, when you once have your wires under ground, the next thing is to get them out for use."

Arc-lighting has evidently come to stay, and wherever the arc-light is, there its connections must be more or less exposed. The experiments of the ignorant, and the carlessness of reckless linemen, will continue to result in casualties as long as arc-lights are used, whether the wires are buried or not.

FUTURE RAPID-TRANSIT FOR MAIL AND EXPRESS MATTER. — There are at present two systems before the public for the rapid transit of mail and other light matter, either or both of which will no doubt prove successful in the near future. The Weems system, an experimental track for which has been built at Laurel, Md., has been illustrated and described at length in *Science;* and the results from the small experimental section already equipped have seemed to justify the construction of a five-mile track, which will soon be completed. This system employs actual electric motors in connection with a light elevated structure, the weight of the car with the motors being something like three tons. Whether such a mass, with its complicated and delicate electrical machinery, will come finally into commercial use, remains to be seen. The other system referred to is known as the Portelectric system, and the motto of the inventor is, "To dispense with mass and machinery." In this system a number of helices are used, taking their current from a metallic circuit on an elevated structure. The car itself is nothing more than a magnetized steel cylinder, pointed at both ends, running on a single track. The mail or other matter is placed in this receptacle, and the successive attractions of the different helices through which it passes augment its speed to a velocity the limit of which is so far unknown. A small section has been on exhibition for some time past in the Old South Church, Boston, and thousands of visitors have witnessed the phenomenal speed of the light steel cylinder, even in the narrow confines of the church. The New England Portelectric Company is now building a demonstrative section on a similar principle in Dorchester district, Boston, Mass., and the results will be looked forward to with interest. The electrical pressure used will be somewhere between two hundred and one thousand volts. The track will be elliptical, and the curves laid at an angle which will justify a speed of at least three miles per minute. The material is now on the ground, and the work is to be pushed rapidly forward. The inventor, Mr. John T. Williams of New York, is considering the extension of this principle to the projection of dynamite cartridges.

THE EIFFEL TOWER AND LIGHTNING. — It has been claimed from the first that the conductivity of the Eiffel Tower is sufficient not only to protect it against lightning, but to protect a large area contiguous to it. It is now claimed that the tower and some of its occupants have recently suffered from a stroke of lightning, and various accounts of "blue flames playing about the structure" have been current in the public press. These reports would be almost incredible, were it not for the fact that the directors have taken cognizance of the matter, and are seriously considering whether the conductivity of the tower is sufficient as it now stands. The safety of the structure is of considerable moment, not only to visitors, but from a financial point of view, when it is considered that a recent week's receipts, exclusive of rentals and privileges, have amounted to the round sum of sixty-seven thousand dollars.

BOOK-REVIEWS.

Institutes of Economics. By E. BENJAMIN ANDREWS. Boston, Silver, Burdett, & Co. 12°.

THIS book has been written because the author thinks that the existing manuals on the subject involve two serious faults of method. One is that they explain every thing too fully, thus leaving too little for teacher and student to do; and the other is that they do not mark by difference of type the distinction between the principles of the science and the examples used to illustrate them. Accordingly, his own presentation of the subject is very succinct, so much so as to deprive his book of all literary form; and his illustrations and much other matter are given in the form of notes. We are strongly of opinion that in both respects he has made a mistake. Economics is too difficult a subject to be adequately taught in so succinct a form as that of this treatise; and the separation of principle and illustration, besides being a literary fault, increases the difficulty of understanding the science. However, nothing but actual use can determine the merits of Mr. Andrews's method, and his work certainly contains a large amount of matter, and shows a thorough mastery of the best works on the subject. His views are substantially those of the English writers, with some modifications due to German thought. The concise character of the work renders some of its expositions obscure, and insufficient for a proper understanding of the subject, this being particularly the case with the account of supply and demand, which is only presented in a note, and very insufficiently there. The author's views are in the main sound, but his theory of "ideal money" can hardly be called so. He would have the State issue all money, both coin and paper; and, when there occurred a general fall or rise of prices, the government should "correct the same by expanding or contracting the circulation." Let us hope that "ideal money" will never come into use.

Handbook of Psychology. Senses and Intellect. By JAMES MARK BALDWIN. New York, Holt. 8°.

THIS volume is the first part of a general treatise on psychology, the second volume being designed to treat of the emotions and the will. It is both descriptive and theoretical, and is intended to present the latest views on the science, so far as these are accepted by the author. The style is plain and easily understood, except in a few places where the writer does not seem to have a perfect mastery of the thought he wishes to convey. Professor Baldwin considers the introspective method as the main instrument of psychological study, though he recognizes the value of the experimental method, so far as its reach extends. He rejects the theory of unconscious intelligence, and gives good reasons for doing so. His discussion of consciousness and of the nature and methods of psychology are among the best portions of the work. His views are to a certain extent eclectic, and reflect the present unsettled state of both psychology and philosophy. He tells us that he studied philosophy under one of the leaders of the Scottish school, and his work reflects in many respects the influence of that school. His classification is similar to theirs, and in particular he follows them in his treatment of reason as the "regulative faculty," the faculty of intuitions. In other parts his work shows the influence of Kant, while that of the empirical school and the physiologists is also apparent. Take, for example, his theory of the perception of

space. He rejects Kant's view that space is a product of our own mental action, and also the empirical theory, which reduces space to sensation, and gives as his own view that "the mind has a native and original capacity for re-acting upon certain physical data in such a way that the objects of its activity appear under the form of space." This theory he expounds at considerable length, but fails to make clear what this "mental reconstruction of space" really is, or even what he considers space itself to be. It is plain, however, that this theory is a compromise, or medium, between the Kantian view and that of the empiricists, and thus illustrates what we mean in saying that Professor Baldwin's work reflects the unsettled state of philosophy. If space permitted, we might incline to criticise some of his other views, and particularly his theory that perception and representation are fundamentally the same, and also some of his views on association. In the present state of opinion, however, no treatise on psychology can be entirely satisfactory; and Professor Baldwin's work, in spite of what we consider its errors, has much in it that is good.

An Elementary Class-Book of General Geography. By HUGH ROBERT MILL. London and New York, Macmillan. 12°. 90 cents.

MR. MILL is the lecturer on physiography and on commercial geography in the Heriot-Watt College, Edinburgh. His book is a descriptive geography, without maps, for which the student is referred to some good atlas, but with a few scattered illustrations intended to convey an idea of specially characteristic features of this or that country, or of scenes typical of the life. For instance, there are given views of a street in London, of a street in Cairo, of the Brooklyn Bridge, and of a hotel in the Blue Mountains, Australia.

In his descriptions we fear Mr. Mill has occasionally, for the sake of vividness, preferred to tell of one phase of the life he is handling, leaving his readers ignorant of the great variations that may exist in different branches of the same people. He tells of the Eskimo as living in their snow-huts in an atmosphere rendered so warm by the oil-lamps that they throw off all their clothing. That this is not the constant practice is well known. Again, the tendency to be a little hasty is shown in the statement that "when the sun is rising at Labrador, it is noonday at Vancouver Island."

The general narrative runs smoothly, however; and the book will be found suggestive by American teachers, though its being written markedly for the young of Great Britain will not inure to its advantage in this country.

AMONG THE PUBLISHERS.

THE Harrisburg (Penn.) *Telegram* is preparing to publish in book form a history of the Johnstown disaster. The volume will meet the popular demand for a full description of the great calamity. Besides, the fact that the net proceeds from the sales will be applied for the benefit of printers' orphan children, and aged men and women who suffered by the flood, commends the work to the favorable consideration of the public. The book will be sold by subscription only.

— The October *St. Nicholas* has contributions from Noah Brooks, Joel Chandler Harris, Celia Thaxter, Elizabeth Robins Pennell, Harriet Prescott Spofford, Julian Ralph, Margaret Johnson, Elizabeth Cavazza.

— Seven writers — clergymen, college professors, and public men, some of them specialists of acknowledged standing — have associated themselves to discuss special questions of social interest and import, and to prepare papers to be afterwards given to the public from time to time in the pages of *The Century*. The writers include the Rev. Professor Shields of Princeton, Bishop Potter of New York, the Rev. Dr. T. T. Munger of New Haven, the Hon. Seth Low of Brooklyn, and Professor Ely of the Johns Hopkins University. For each paper the author will be responsible, but he will have had the benefit of the criticism of the other members of the group before giving it final form. The opening paper will be printed in the November number. *The Century* also has in preparation a series of papers on topics relating to the gold-hunters of California. The articles will be prepared for the most part, as were the war papers, by prominent participants in the events which they describe; and they will include accounts of early explorations, life in Calfornia before the gold discovery, the finding of gold in 1848 at Sutter's Fort, the journey to California by the different routes (around the Horn, across the plains, by Nicaragua, and by Panama), life in the mining-camps and in San Francisco, and other important aspects of Calfornia life at the time. It is believed that these papers will be in the nature of a revelation to the reading public of the present day as to many interesting aspects of the pioneer period, its romance and adventure, its tragedy and pathos, and its poetry and humor. A careful search in California and elsewhere has already brought to light many interesting pictures never yet engraved. The publication of the papers will not be begun until the series is further advanced.

— Mr. M. F. Sweetser, for the past seventeen years connected with James R. Osgood & Co. and Ticknor & Co. as writer of their capital series of American guide-books, has become editor-in-chief for the Moses King Corporation. For a long time he will be exclusively engaged on the mammoth "King's Handbook of the United States," the most important and costly work of the kind ever published, and which will be issued next year.

— The success of Marshall P. Wilder's book, "The People I've Smiled With" (Cassell & Co.), has surprised no one more than that amiable little fellow, its author. He knew that he had a great many good friends, who would buy it and read it, but he did not know that they were to be counted by the thousands. The sale of this book has been second only to that of Max O'Rell's "Jonathan and his Continent."

— Messrs. G. P. Putnam's Sons announce as in preparation "An Experimental Study in the Domain of Hypnotism," by R. von Krafft-Ebing, professor of psychiatry and nervous disease in the University of Graz, Austria, translated by Charles G. Chaddock,

M.D., assistant physician Northern Michigan Asylum; "The Story of the Bacteria and their Relations to Health and Disease," by T. Mitchell Prudden, M.D., author of "A Manual of Practical Normal Histology;" and "Through the Ivory Gate," being studies in psychology and history, by William W. Ireland, author of "The Blot on the Brain."

— Ex-Postmaster-General Thomas L. James has prepared an explanation of needed postal reforms, which will appear in the October *Forum*. Mr. James declares that the railway mail service is twenty years behind the times, and ought to be very greatly improved; that small offices near to one another ought to be consolidated under one management, so as to save expense; and that ocean postage ought greatly to be cheapened. Senator Cullom of Illinois will have an article in the same number on "Protection and the Farmer," to show that the farmers are benefited by a protective system more than any other class. Mr. Edward Wakefield, a member of the Australian Parliament, who has been elected and defeated many times under the Australian ballot system, will contribute to this number an explanation of the practical workings and of some defects of the system which has been so much discussed in this country. Professor William T. Harris, United States commissioner of education, writes a critical examination of Edward Bellamy's "Looking Backward."

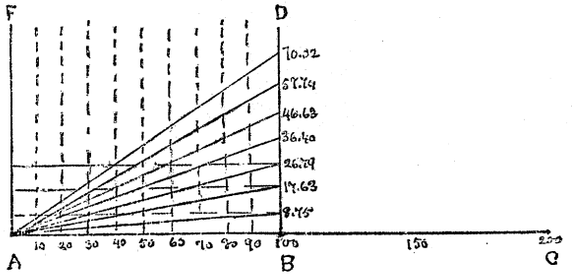
LETTERS TO THE EDITOR.

A New Method for ascertaining Heights and Distances in Right-angled Triangles.

ABOUT four years ago I devised a method whereby the solution of right-angled triangles, for the taking of distances and heights, is much facilitated by a tangent scale on the instrument.

The principle depends upon the well-known fact that the perpendicular of a right-angled triangle is equal to the tangent of the included angle multiplied by the base.

The graduation is accomplished as follows: we take a base-line (say, of 100, for convenience), and an angle of five degrees. Com-



FA and *DB* represent the rights of an ordinary surveying-compass; *DB* containing the scale, and sliding upon *ABC*, which contains the numbers 1-200 marked in equal divisions.

puting this, we find the perpendicular to be 8.75 feet, yards, or metres, in whatever system the base was measured.

This is marked on the arm *BD* instead of five degrees. The computation is continued for the various angles, and the results marked upon the scale. This for a base of 100. Now, if the observer is placed only 50 distant from the object, *DB* is moved to that point on the scale *ABC*, and the height is seen to be the same as before; for, at a distance of 50, an angle of ten degrees, which is observed by going one-half nearer, is subtended by a perpendicular of 8.75, as before: so by moving the scale backward or forward, corresponding to the base-line taken, the height of an object can be immediately read off, provided the side of the object contains the height; if it does not, other means of triangulation have to be adopted, several methods of which can be readily improvised by one accustomed to such work. Horizontal angles can be solved in the same manner by having the rim of the compass-box graduated for a given base-line; then by using this base-line, and taking the distance between the observed points to represent the perpendicular of the triangle, the distance can be read directly from the instrument.

HARVEY B. BASHORE.

West Fairview, Penn., Sept. 13.

Brocken Spectre.

THIS phenomenon has been associated with the Brocken, one of the Hartz Monntains in Germany, about 3,700 feet in height, because more often observed from there. It has given rise to a large number of remarkable theories in explanation, many of which originated with those who had never seen it. An exhaustive article, giving a *résumé* of records regarding it, will be found in the *Quarterly Journal of the Royal Meteorological Society* for 1887, at p. 245. The explanation having the widest acceptance was published in the above article, and later in the *American Meteorological Journal*, August, 1889, and is as follows: the eye is deceived by the apparition, and thinks it much farther away than it really is. It seems to me that this is hardly tenable. The only way in which the eye could be deceived would be in case the shadow were formed a long way off; but, if it were really formed near the eye, it would appear in its natural size. When one looks into a concave mirror, the eye is at first deceived, thinking the mirror plane; but in this case the deception is very plainly due to the action of the mirror.

The very singular explanation is given in "Johnson's Cyclopædia," that "the vapors of the atmosphere act as a vast concave mirror." Singular as it may seem, however, it is probable that this is, undesignedly, more than half correct. A short stay on the summit of Mount Washington has shown this spectre in all its phases. The best time to see it is either in the early morning or just before sunset, and when the fog is not too dense to hide the sun. If the observer turns his back to the sun, he will see on a bank of fog, if it does not envelop him, a slightly diminished shadow of himself. The eye is not deceived in any case as long as the fog forms a nearly vertical wall at fifty or more feet distance. If, now, the fog envelops the person, the shadow appears to start directly from him, and often seems very large. There is no deception of the eye at all, if one is accustomed to careful observations.

The following is advanced as a probable explanation. The shadow of the person is cast upon the fog in solid form; that is, the object shuts off the light of the sun, and one sees only the surface of his own solid shadow looking into its axis. The arms and legs also cast solid shadows, and the person sees the movement of these outside of the shadow of his body. It may be better understood to call to mind the shadow one sees on the ground as the sun is setting. This gradually grows longer and longer, and at last disappears in the distance. The fog forms a sort of "ground," and the shadow is cast upon it. It is possible to form the same shadow with a lantern which concentrates its rays by a reflector. There is no difficulty, in a fog, in seeing the shadow enormously enlarged. Scores have seen it on Mount Washington. It might be thought that the nearness of the light was the cause of the enlargement; but this was not the case, for the shadow began exactly at the person where it could have been only the natural size.

The familiar appearance of "sun drawing water" will help to explain this phenomenon. In this case the air is full of haze or fog, and a small cloud casts a solid shadow thousands of times as long as itself. The surface of this is what we see. If an eye were placed in the edge of the cloud casting the shadow, the latter would appear on all sides. In the case of the spectre, this same solid shadow could be seen by a second person standing and looking across it, provided the light of the sun were not dimmed by the fog. It is to be hoped that we may have more observations of this interesting phenomenon.

H. A. HAZEN.

Washington, Sept. 23.

Note on the Anserine Affinities of the Flamingoes.

A CLOSER study of the structure of a member of the groups of existing birds is throwing a new light in upon their relationships, and at the same time somewhat disturbing some very crude and preconceived notions as to their affinities.

For a great many years past, some of the most distinguished of zoölogists have insisted that the position of the flamingo was "so completely intermediate between the anserine birds on the one side, and the storks and herons on the other, that it can be ranged with neither of these groups, but must stand as the type of a division by itself." Recently, Professor Parker (*Ibis*, April, 1889) has said, in reviewing the structure of the wing in the flamingo (*Phœnicopte-*

rus), that "on the whole, this is a very perfectly formed wing, and is more like that of an ibis than that of a goose, as, indeed, is much of the structure of *Phœnicopterus*."

No less eminent an authority than Professor Huxley has strongly contested the point that the flamingoes are more nearly related to the geese than any other birds known to him; and I believe heretofore all American ornithologists had the same idea. From my own studies, I am confident that the above opinion of Professor Parker will prevail in the future, and fuller researches into the structure of the several types in question will prove it to be the correct one.

R. W. SHUFELDT.

Takoma, D.C., Sept. 19.

INDUSTRIAL NOTES.

A Good Record from Buffalo.

AMONG the cities which are now adopting electricity as a motive power on their roads is Buffalo, N.Y. The Buffalo Street-Railway Company of that city, about two months ago, made a contract with the Sprague Electric Railway and Motor Company of New York for the equipment of four electric cars. This equipment was intended only to try the electric system; and, if the trial should be successful, it was contemplated that an equipment of a very large number of cars would be operated upon this road. The cars have been in operation about four weeks, and carry large numbers of passengers. Upon a recent Sunday, the four cars and four trail cars carried twenty-five thousand passengers without the loss of a single trip. This is a notable record, considering the small number of cars operated and the grades upon this line. The people in Buffalo are enthusiastic over the new system of propelling street-cars, and say that the management will soon give an order for an increased equipment.

New 75 Horse-Power Electrical Motor.

UP to this time, nearly all the electrical manufacturers have confined themselves to small motors; and although all have acknowledged that the transmission of power on a large scale is feasible and practicable, yet, so far, it has been found commercially more desirable to keep down the size of motors to something like 25 horse-power or less.

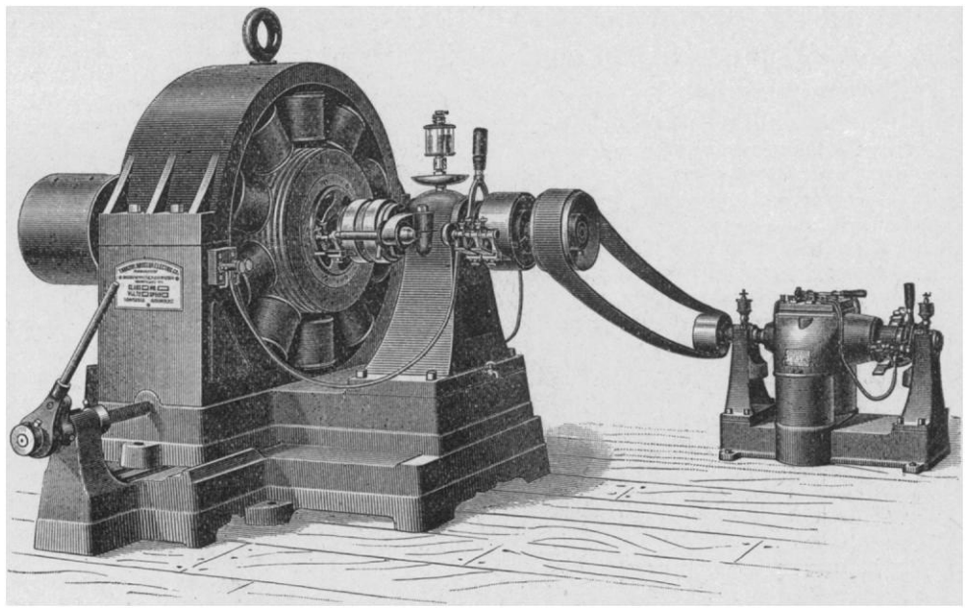
We understand the Sprague Electric Railway and Motor Company of New York has departed from this routine, and that they have received a number of orders recently for a larger motor, which have had the result of calling forth the present new 75 horse-power motor, which is by far the largest electric motor which has ever been built. This machine is not dissimilar in appearance to the ordinary Sprague standard electric motor of smaller sizes.

The first one of these motors manufatured was for the Kearney Paper Company of Kearne, Neb., where about 120 horse-power of electric motors built by the Sprague Company will be used for operating the entire mill. The current for driving these motors is generated by water several miles away. The second of these motors has been built for a long-distance transmission power plant which the Sprague Company have ordered for erecting in South Africa. Other machines of the same size and type go to other parts of the world through the large demand for motors of this size in long-distance power transmissions, mining-work, and general industries.

The efficiency of this machine is claimed to be high, while at the same time the speed is kept quite low; the motor making only about 500 revolutions a minute while operating under full load.

TheThomson-Houston Alternating-Current Dynamo.

UNQUESTIONABLY the most economical and valuable dynamo in central-station use for long-distance lighting is the alternating-current machine; and its recent adoption for its practical working in this country, although but a matter of a short time, has caused a great change in the methods of supplying illumination by incandescent lamps. The economy with which the electric light can be produced is dependent primarily upon the source of power for operating the dynamos, and the use of the alternating current renders it possible to locate a central station with particular reference to coal and water supply; and the fact that a high-potential current can be transmitted long distances over a small wire, and at a small loss, renders it possible to make use of available water-powers, which could not be done by any other system. Then, again, the cost of maintenance and construction is greatly reduced, as a current can be conducted to a centre of distribution, from which the circuits for the immediate supply of current to the lamps can be taken.



THE THOMSON-HOUSTON ALTERNATING-CURRENT DYNAMO.

We illustrate herewith the improved alternating-current dynamo made by the Thomson-Houston Electric Company, which has met with such a deserved success in central-station work. It is a feature of this machine that it is of simple construction, and can readily be taken apart to allow examination, or replacement of any part which may have become injured. This machine embodies most excellent features in construction of the armature, whereby all tendency to overheating is obviated, and its regulation is such that extreme changes in load do not cause any change in the intensity of the light. The dynamo has been largely introduced by the company, and has everywhere met with success.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities."—P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited. — E. E. Bogue, Orwell, Ashta. County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for $2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 × 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4" × 5"), for fine geological or mineralogical specimens, properly classified. — Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc. — Alda M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition. — Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection. — W. C. Thompson, 612 East 141st Street, New York, N.Y.

A few first-class mounted birds, for first-class birds' eggs of any kind in sets. — J. P. Babbitt, secretary Chapter 755, 10 Hodges Avenue, Taunton, Mass.

Mineral Lands.

MANGANESE DEPOSITS. — A rich deposit of Manganese is for sale. Apply to H. N., care of *Science*, 47 Lafayette Place, New York.

GOLD-BEARING QUARTZ VEINS. — Any one wishing to engage in gold mining will learn of a newly discovered vein by applying to H N., care of *Science*, 47 Lafayette Place, New York.

RED SLATE. — A valuable deposit of red slate for sale. Apply to H. N., care of *Science*, 47 Lafayette Place, New York.